MACHINE DESIGN

VOLUME 7 APRIL 1935 NUMBER 4

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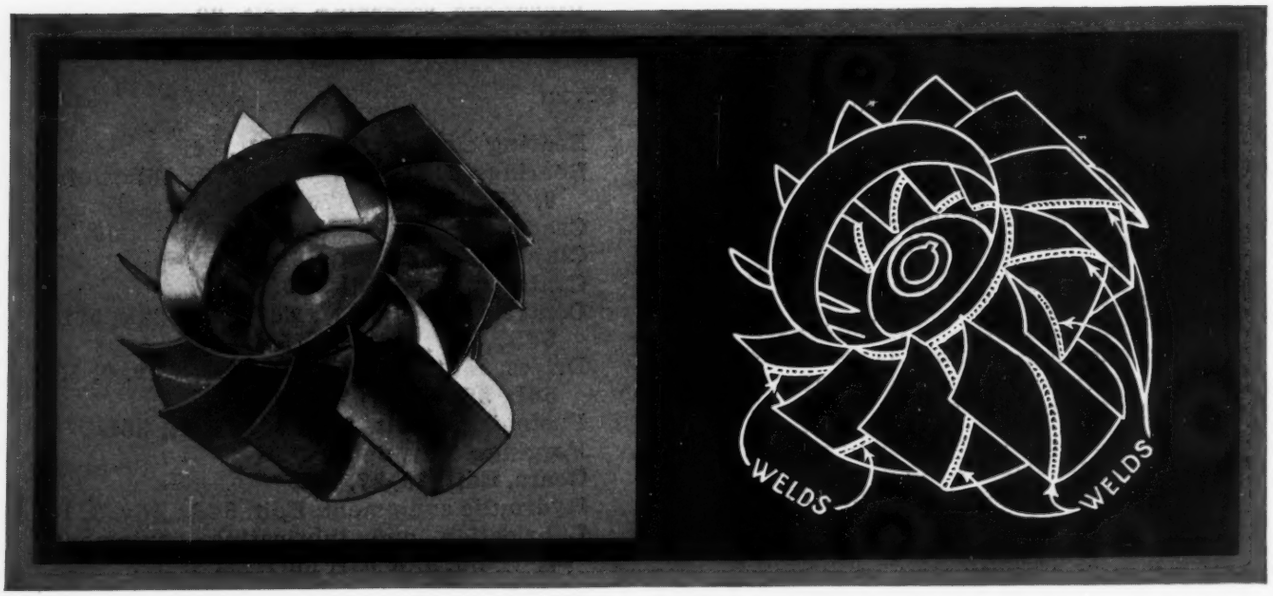
ITEMIZED INDEX

Classified for Convenience when Studying Specific Design Problems

Key: Edit., Editorial Pages; Adv., Advertising Pages; R, Right hand column; L, Left hand column

WELDING Design Simplifies Assembly



• Oxwelding proved to be the only practicable way to fabricate these turbine-type mixers. The welding blowpipe eliminates cumbersome mechanical fabrication; assures fast production with smooth, strong joints; and each curved blade is easily joined to the central shaft and outer brace. On the smallest mixer, for fine material, there are 72 in. of welding; on the largest, for coarse material, welded seams total 22 ft.

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DANLY SMITHWELDING

CALENDAR OF MEETINGS AND EXPOSITIONS

April 15-May 15—

National Alliance of Art and Industry.

Exposition which will include machinery and products designed for eye appeal will be held in the forum at Rockefeller Center, 30 Rockefeller plaza, New York. Information on the exhibit may be obtained from Thomas J, Maloney, 386 Fourth avenue, New York.

April 22-26—

American Chemical society.

Semi-annual meeting to be held at New York. Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary of the chemical society.

April 22-26—

Knitting Arts Exposition.

Thirty-first annual exposition of machinery and products to be held at Commercial museum, Philadelphia. The exhibit is sponsored by National Association of Hosiery Manufacturers, Commercial museum, Philadelphia.

April 25—

American Welding society.

Annual meeting to be held at Engineering Societies building, New York. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary of the society.

May 6-10—

Water Works Manufacturers association.

Annual meeting and exposition of equipment, and annual meeting of American Water Works association to be held at Netherland-Plaza, Cincinnati. John A. Kienle, 60 East Forty-second street, New York, is secretary of the manufacturers association.

May 11-14—

National Electrical Manufacturers association.

Spring meeting to be held at The Homestead, Hot Springs, Va. R. J. Blais, 155 East Forty-fourth street, New York, is secretary of the association.

May 13-15—

American Institute of Chemical Engineers.

Semiannual meeting to be held at Hotel DuPont, Wilmington, Del. Frederic J. LeMaistre, 808 Bellevue Court building, Philadelphia, is secretary of the institute.

May 14-15—

American Gear Manufacturers association.

Annual meeting to be held at the Penn-Lincoln hotel, Wilkinsburg, Pa. J. M. McQuiston, Penn-Lincoln hotel, is manager-secretary.

May 20-23—

National Association of Purchasing Agents

Annual meeting and information show to be held at New York. G. A. Renard, 11 Park place, New York, is secretary of the association.

May 22-24—

American Society of Refrigerating Engineers.

Semiannual meeting to be held at Hotel Statler, Buffalo, N. Y. David L. Fiske, 37 West Thirty-ninth street, New York, is secretary of the society.

June 3-7—

National Confectioners' Association of the United States, Inc.

Exposition of equipment and annual meeting to be held at the Palmer House, Chicago. The exposition is being managed by Roberts Everett Associates, 232 Madison avenue, New York.

June 16-20—

Society of Automotive Engineers.

Annual summer meeting to be held at White Sulphur Springs, W. Va. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary of the society.

June 17-19—

American Society of Heating and Ventilating Engineers.

Semiannual meeting to be held at Royal York hotel, Toronto, Ontario, Canada. A. V. Hutchinson, 51 Madison avenue, New York, is secretary.

June 24-28—

American Society for Testing Materials

Thirty-eighth annual meeting and exhibit of testing apparatus and related equipment will be held at Book-Cadillac hotel, Detroit. C. L. Warwick, 260 South Broad street, Philadelphia, is secretary of the society.

MACHINE DESIGN

THE JOHNSON PUBLISHING CO., CLEVELAND, OHIO

April, 1935 Vol. 7—No. 4

Designing for Appearance

By Harold L. Van Doren

Van Doren & Rideout, Toledo, O.

Part III

NO AMOUNT of training in the pure theory of design will make one a good designer if he lacks genuine sympathy with the practical problems of shop practice and production economy. And by the same token, no matter how sound his knowledge of engineering principles may be, he will be completely helpless when faced with a design-for-appearance problem without some understanding of the principles involved in that special field.

In previous articles we have dealt largely with theory, using abstract diagrams to illustrate some of the fundamentals of Rhythm, Proportion, Balance and Unity. It is time we chose some actual problems and tried to apply these

Gas conversion burner illustrates effect which may be gained by careful attention to design. Photograph courtesy Van Doren & Rideout

principles in a practical manner.

Let us suppose that we have just begun work with a manufacturer of domestic gas heating equipment. This gentleman would like to improve the appearance of a line of gas furnaces. He manufacturers several types: Gravity, forced air, etc., each in several price ranges, but the large volume is in the lowest price line, highly competitive.

We foresee at once that cost is going to be a big factor. A few dollars added to the cost will be multiplied several times in the price to the consumer. But design economies have already been effected by more efficient methods of drilling the ports in the burners and assembling the baffles. Therefore, rather than lower the price, which is already in line with competition, the manufacturer decides to spend a little additional on appearance.

A visit to the showroom is frankly discouraging. We are the plastic surgeons, and here are our patients. Our job is to touch up their noses, straighten their teeth and remove the freckles. The manufacturer knows his units are not much for looks, but they are his babies, and he has a justifiable pride in his offspring.

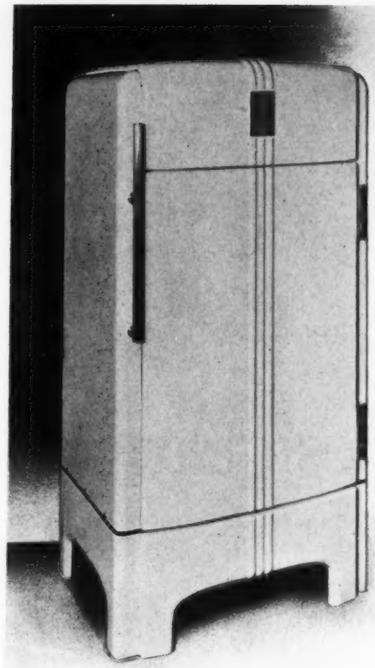
We Start with an Ugly Duckling

The low-priced furnace, our first face-lifting job, is a particularly ugly duckling. Like most equipment of its kind, designed for the huge low-priced house-heating market, it consists of a fat cylinder of galvanized sheet metal, surmounted by a bonnet of the same material in the form of a truncated cone, from which, like the tentacles of an octopus, radiate the ducts. Close to the floor is a cast-iron plate, on which are arranged various controls: A motor-control unit, automatic pilot, regulator, valve, manifold, etc. For slightly higher-priced models, there will be a humidifier pan.

We observe that the cylinder is made up of two long sheets wrapped horizontally and drawn together at the back by bolts, over a T-shaped ring. An opening is cut in the lower sheet for insertion of the control mountings. The furnace is shipped KD, with these sheets rolled tightly together. This precludes prefinishing the sheets, for by the time they were installed by the erection man, they would be marred and scratched out of all recognition. The bonnet (the truncated cone mentioned in the foregoing) is shipped blank, and the holes cut on the job by the erection man to fit the ducts, depending on the requirements of the particular house.

We are faced, therefore, with a startling array of "dont's." We can't paint the sheet metal. There is no use of trying to make the cylinder into an oval (foolish on the face of it), or square (that's another class of furnaces made by the same company, requiring an angle-iron frame) or hexagonal (expensive to form the metal). The bonnet can't be a stamping (enormous dies, and the holes have to be cut on the job anyway). Apparently anything we try to do to the main body of the furnace would cost so much that it would be put immediately into a higher price bracket, competing with another unit in the line.

So we are left with the control panel. We suggest that it be housed in completely, by means of a form, or series of forms, which would cover the miscellaneous assemblage of smaller shapes and give a certain unity to the whole furnace. This suggestion meets with some in-



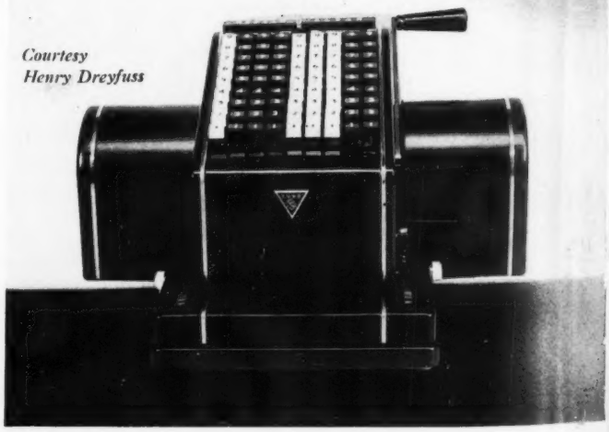
Design for Appear

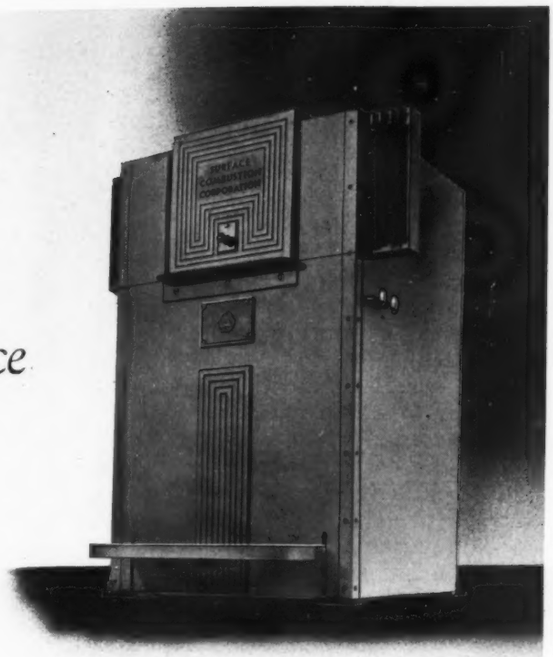
Courtesy
Raymond Loewy

Courtesy
Lurelle Guild

Courtesy
Raymond Loewy

Courtesy
Henry Dreyfuss





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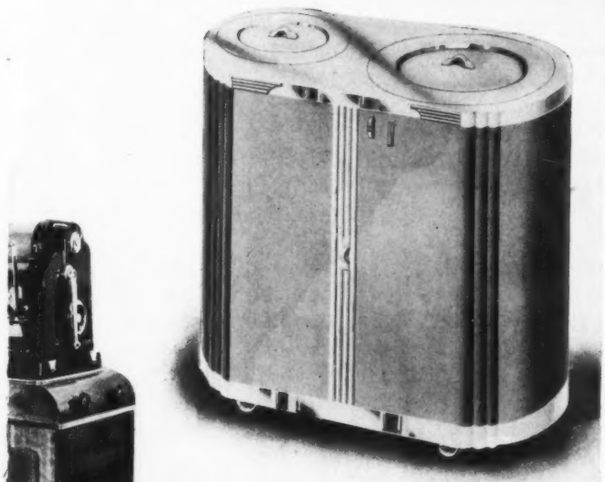

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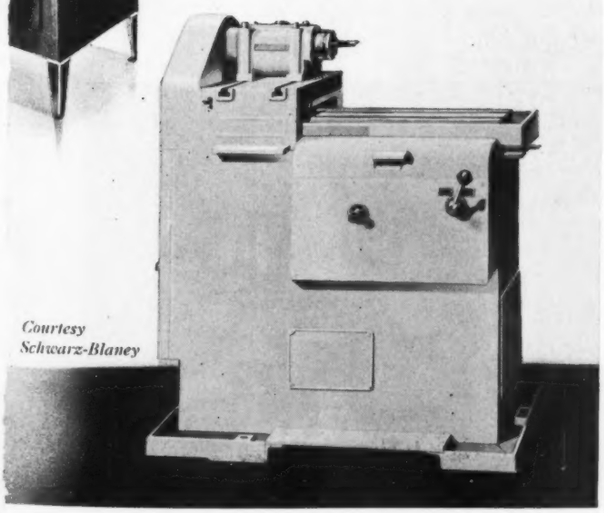
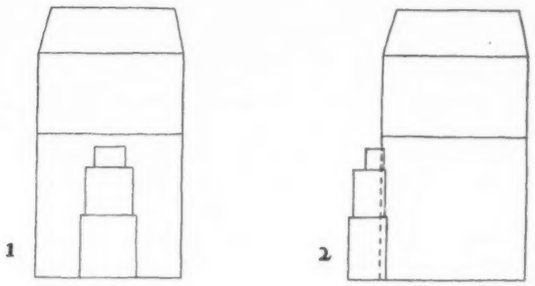


Courtesy
Schwarz-Blaney

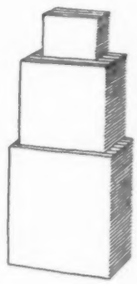
terest, so we gather all available data and set to work. Fortunately the whole furnace is undergoing a complete mechanical overhauling, so the management is not averse to regrouping the controls. We set about to determine the clearances necessary to house all the controls.

The result is as follows:



In other words we have three roughly cubical shapes superimposed one upon the other, starting at the floor, and extending more than half the height of the cylindrical body of the furnace. The bottom cube takes care of the manifold and regulator. Immediately above the regulator is the valve, and extending upward into the second cube is the motor control with its dome-like housing. The third cube encloses the neck of the humidifier pan.

What shall we do with it? The first thing is to get it into perspective. Remember that we are dealing in masses which we must manipulate so that the entire housing will have a unified and coherent appearance. We draw an accurate mechanical perspective of the three cubes, as at the right.



Unfortunately, none of these cubical shapes offer any pleasing possibilities in themselves. They are a miscellaneous lot, ill assorted, and thoroughly uninteresting. They are little better than a heap of building blocks as left on the floor by little Willie before his afternoon nap. If we try to apply any of the rectangles which we constructed in Part I of this series to the front or sides of these cubes, we will be sadly disappointed. And we know that we cannot distort these shapes, because we are trying to enclose the controls inside as economically as possible. We should avoid, whenever possible, housing just "air."

There are other limitations. We must have a door eleven inches wide on the front so that the controls can be removed without removing the entire housing. And the top cube must be independent of the rest so that the householder can remove it easily to fill the humidifier pan.

Our first step in the procedure would be to place the perspective outline shown in *Fig.* 3 under a sheet of tracing paper and try various sketches over it. We must be careful, however, not to forget the shape and general character of the whole furnace while working on this component part. The furnace itself is an assembly of circular, cylindrical or conical shapes. Therefore it would be out of keeping to design the control housing so that it was composed principally of angular shapes. We might begin by rounding off the cubes themselves in an attempt

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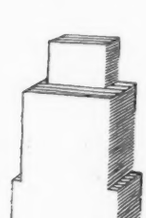
to make one melt into the other, thereby mitigating their angularity, left.

Not so good. They are still so many boxes, one set on top of the other. Furthermore, we would have a high time trying to fit a door to those two lower cubes. They need some further manipulation. What shall it be? Well, for one thing, we observe that the middle cube is only about an inch shallower than the bottom one, front to back. Surely we can take the liberty of allowing a little extra clearance for the motor control unit, left



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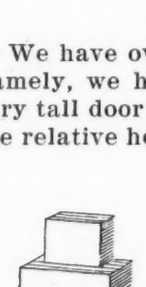
Distinctly better, you will admit. We have at least blended the two lower cubes, so that they become one shape. But it is not particularly pleasing. Further treatment is necessary. Why not make that central vertical form into a dominant motive by pushing back the sides of the lower cube? We consult our prints and find that there is no interference at this point, so the shape at left is developed.

We have overcome one very definite objection namely, we have provided space for the necessary tall door for servicing the mechanism. But the relative heights of the "wings" and the main body are not good—the wings cut it about in half. Again we take liberties for the sake of appearance and raise them to roughly two-fifths of the height of the vertical shaft. Then we introduce radii, cut some ventilating louvres in the door, add handles to the door and to the removable humidifier-neck cover on top, apply an instruction placque and some decorative ribs, and make up an actual sized wood model, painted with the colors we have chosen. *Fig.* 7 is the result.



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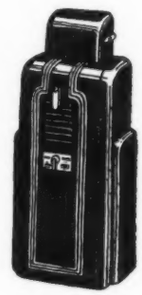
We are not allowed much leeway with the body of the furnace, but we can tie the housing in with the furnace by prestriping a band around the base, close to the floor, with instructions to the erection man to fill in below the stripe with solid black from his touch-up pot.

Now for another example, a "study in limitations." Our furnace control housing was comparatively simple, for the elements to be enclosed permitted of some juggling. Our next problem, however, is considerably more difficult.

This time we are working for a manufacturer of household laundry machinery, and he turns us loose on an electric ironing machine. He holds patents on a clever type of hood that covers up the operating mechanism when the ironer is not in use—which in most homes is six days a week. It is natural, therefore, that he should be most concerned with the appearance of the exterior. He expects to build entirely new dies, so we have a pretty free hand. "Go as far as you like, boys, we want the finest looking ironer on the market."



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So far so good. There are plenty of problems involved, but not of the sort to give us gray hair. The sketches have been presented and approved, wood models have been built from detailed drawings and changed and altered until everyone is satisfied and happy.

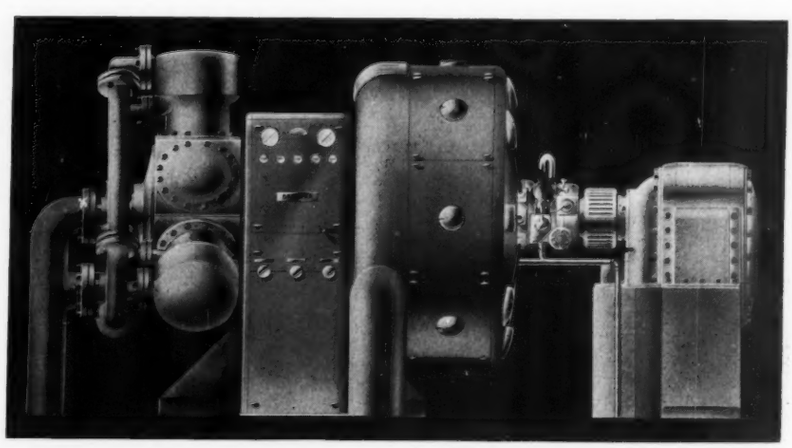
Interior Appearance Neglected

Now comes the rub. We point out that the inside has not been touched. The gear housing is pretty dead looking, the control handles are commonplace—in other words, when the lid is up, when the jewel box is opened, we find nothing but paste gems inside.

"Sorry," says the president. "The dies for the hood and body will use up all the money we can spend on this machine. Of course, if you can do something without its costing any more money, except for a few patterns, go to it."

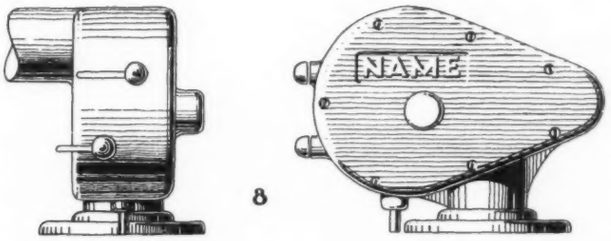
Now there's a problem! Every designer has heard it a thousand times. "Make it better, but don't spend any money."

No changes are to be made in the gears. Consequently the bosses inside the gearcase, which must be machined to take the bearings, can't be touched without scrapping all the jigs and fixtures. Remember, all the traffic will bear is a few comparatively inexpensive patterns. What can we do under those conditions? Let's have



Maze of piping and unassociated parts is combined to give pleasing appearance in 600-horsepower radial engine and compressor. Photograph courtesy Walter Dorwin Teague

a look at the critter. Here is a front and side view:



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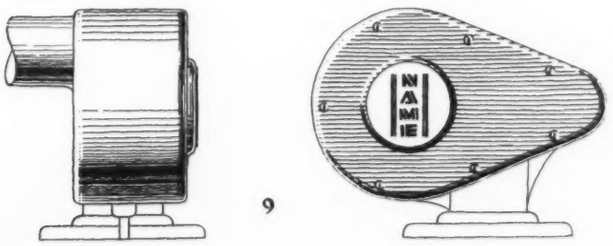
Here is a casing, roughly ovoid in shape with a rather sharply tapering end, supported in a very awkward place by a short pedestal with a flanged base. The front face of the casing has been pushed out (to take one of the bearings) into an ugly boss, which, to make matters worse, is off center. The name of the machine is cast in the housing cover, in ugly block letters. The clutch rod pokes through the sheet metal "floor" of the machine and enters the gearcase from below.

Note that none of the elements we have to deal with bears any *visual* relation to any other part. The ironer *works,* yes, but it might be a lot better looking and still work just as well.

The gearcase cover and the main body of the case have to be surface ground and screwed together with seven screws which show on the outside. There is a fiber gasket and the entire casing is enameled. The enamel covers up the seam.

Prominence of Part Reduced

Here are the changes we propose, in order. To give some coherence to the end cover of the gearcase, we find that by increasing its depth about three-eighths of an inch, we can reduce the prominence of the ugly boss which protrudes from it. Then by substituting a raised circular panel, greatly larger than the original boss, and concentric to the large circular end of the "egg,"



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we can cover up the bearing boss entirely and obtain a place for the brand name.

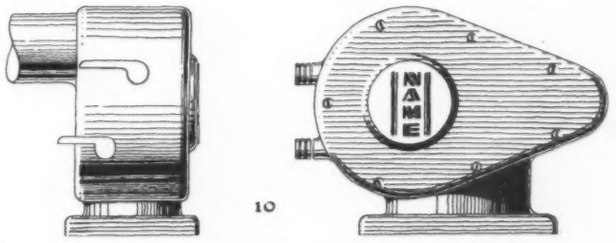
Thereby we have killed two birds with one stone. The name is now on a separate label of black and satin-finished chrome, inexpensive to produce. Incidentally, we have made the whole gearcase cover simpler, and hence cheaper to grind and buff.

In the original, the radius around the edges was so generous that the screws bit into the radius. We decrease it so that each entire screw head is on the flat surface (see *Fig.* 9). Where the main bearing, carrying the machine shaft, joins the gearcase housing, we had a bad condition because the cylindrical form ran flush into the gearcase, and there were two different radii trying to meet and not getting along very well together. We increase the overall size of the housing slightly, enough so that with the new small radius at the edge, we now have a distinct ridge where before was a mushy, indefinite shape. (Compare *Figs.* 8 and 9.)

Now for the pedestal. In place of the single cylindrical pedestal, badly off center (so that it

In response to numerous requests, reprints of Mr. Van Doren's series of articles on "Designing for Appearance" have been made available at twenty-five cents postpaid.

does not appear to carry the weight of the casing above it), plus the clutch shaft, we design a pedestal which takes in both elements, having a base which, in plan view, is rectangular, instead of circular, thus harmonizing with the entire rectangular design of the ironing machine. The final result is as follows:



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After a few clean-up jobs, such as redesigning the chrome-plated control levers and carefully shaping them so that they fit the thumb perfectly, we are through. Total cost—a few new patterns and a name plate. Total effect—now the hood can be raised without apologies. The consumer can no longer say that the machine has a Queen Anne front and a Mary Ann back.

These two brief examples will have to suffice to show how forms can be manipulated to make hum-drum products more esthetically appealing. I hope they prove that the artist-designer's approach to a problem is not incompatible with sound engineering practice. In fact they are meant to show that more careful attention to the visual aspects of a machine or product should be of real concern to the engineer. But he must shed for a time his preoccupation with details, and stand away from the problem long enough to see it with a fresh and unbiased eye.

SCANNING THE FIELD FOR IDEAS

ATTACKING VIBRATION AT ITS SOURCE

TIME was when vibration was considered more or less a necessary evil in machinery. Every effort was made to isolate the offending members by insulation and thus keep the vibrations from being transferred to other parts of the machine. Today, however, the engineer is attacking the problem by going directly to the source of trouble.

Turbine design provides an excellent example of the new trend. Designers have long felt the need of satisfactory means for determining the actual vibratory behavior of a blade or a group of blades mounted in a turbine and rotating at operating speed. An important approach toward the solution of this problem has been achieved by Westinghouse engineers in the development of an instrument for recording visually or photographically the vibrations occuring in standard blades mounted on a rotating disk and subjected to forced vibrations of known intensity, *Fig.* 1.

Besides the disk which is mounted on a hollow shaft and grooved to receive the blading, electromagnets are located at suitable points around the circumference at either side of the blade row, by means of which any type of forced vibration likely to occur in the actual turbine can be simulated. Also employed is a source of light capable of projecting a beam by means of mirrors on to a tiny spherical mirror soldered to one of the groups of blades. These devices, together with means for observing visually or recording photographically the trace of the reflected light beam from the mirror, complete the equipment.

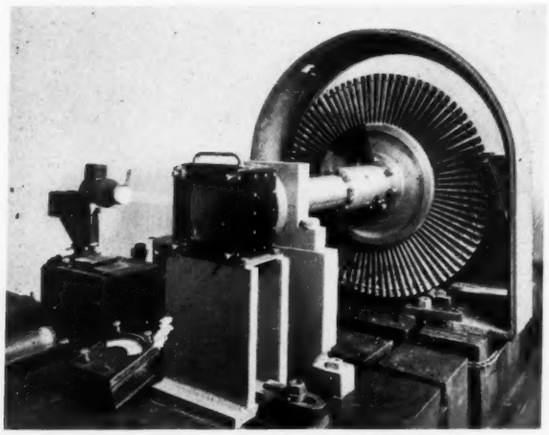


Fig. 1—*Apparatus for study of vibration of turbine blading provides either a visual or photographic record*

The trace recorded on the photographic film, *Fig.* 2, which is given as an example, at known rotative speed and with known input to the energizing magnets shows at once the mode and amplitude of the resulting vibration and consequent stresses set up in the blades. Value of such data in arriving at the correct design cannot be over-estimated.

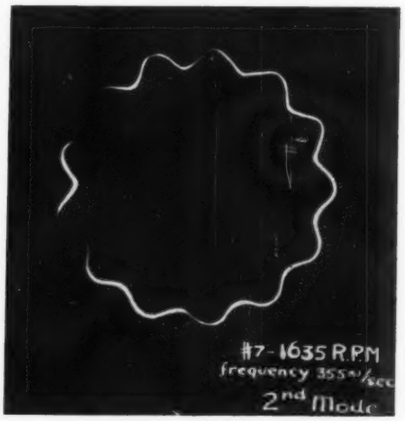


Fig. 2—*Typical vibration record made with optical blade vibration recorder, showing mode and amplitude of the vibration that sets up stresses in the blades*

CHOICE OF STEEL SOLVES PROBLEM

OFTEN the choice of materials is the deciding factor in successful design. What other engineers have found advisable in this respect can frequently be utilized in new work. The following is a case that contains a suggestion which may be helpful.

Brake bands used on oil well drilling equipment require special consideration, particularly because the machines must bear the burden of raising and lowering the drill pipe in wells of great depth. In certain models of machines built by International Derrick & Equipment Co., the brake bands were made from mild carbon steel plate, but because of the low strength of

the material it was necessary to employ a rather heavy gage, ⅜-inch thickness, which was not satisfactory because its stiffness prevented uniform application of braking surface to the drum. Also, when the pressure was released the steel did not have sufficient resiliency to clear the lining of the drum. Because of the low yield point of the carbon steel the bands often acquired a permanent set from merely sagging under their own weight, even when lying in storage before being assembled on the machine.

The engineers then tried a medium manganese semi-alloy steel of about 60,000 pounds per square inch yield point and 90,000 pounds tensile strength, but this did not accomplish the desired improvement. Subsequently a steel produced by Henry Disston & Sons Inc. was placed in service after various preliminary tests had demonstrated its suitability. This was a high carbon nickel molybdenum steel. After cold rolling and heat treatment, properties were developed as follows: Yield point 150/180,000 pounds per square inch; tensile strength 190/200,000 pounds; brinell hardness 380/420.

Brake bands made from this steel retain their shape during handling and when installed behave in much the same manner as spring steel in clearing the brake lining from the hoist drum when the brake is released. Moreover, the band thickness has been reduced from ⅜ to 3/32-inch by the use of the new steel.

SAFEGUARDING THE MOTORIST

THAT safety merits primary consideration in design frequently has been emphasized here. Though the utility of a machine may be unprecedented it cannot be considered one hundred

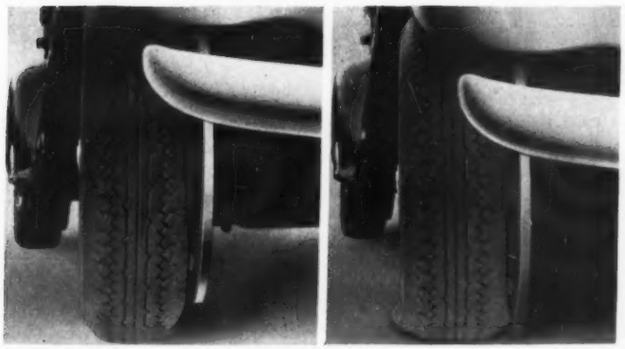


Fig. 3—An emergency wheel safeguards motorists when blowout of tire occurs at high speed

per cent successful unless it embodies genuine safeguards to life and limb. Sometimes the engineer is so absorbed in his objective to acquire speed, for example, he overlooks the danger that threatens the man who operates his machine. While the automobile may not fit precisely in this particular case, it nevertheless serves to illustrate the point.

At the speeds which our present cars are capable of attaining a blowout more often than not is disastrous when it occurs in the higher ranges of speed. The problem always has been a source of concern to the rubber manufacturer who has made tremendous strides in producing sturdy tires. Until the tire guard, *Fig.* 3, was developed recently ideas for a purely mechanical device were somewhat lacking. The innovation is essentially a spare wheel which cushions the shock caused by deflation of a tire when it is punctured.

Manufactured by the American Tire Guard Co., the member is hubless, spokeless and provides a unique inner wheel so attached to the wheel rim that it becomes an integral part of the automobile. Of smaller circumference than the normal tired wheel, it is claimed to eliminate any tendency of the car to swerve on the road and get out of control when a blowout occurs.

AUTOMATICITY BY USE OF LEVERS

INGENIOUSLY arranged levers are being employed to accomplish automatic operation in the new Dictaphone transcribing machine.

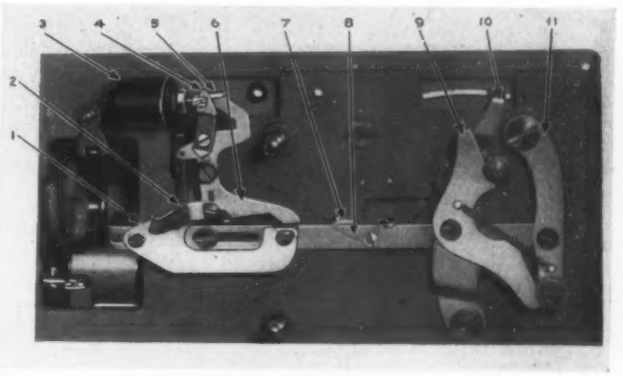


Fig. 4—Interconnection of switch and cylinder ejector of transcribing machine effects automatic operation

The motor switch and cylinder ejector are interconnected so that the motor is started automatically whenever an operator places a cylinder on the machine for transcription. As the cylinder ejector is operated to remove the cylinder the motor stops.

When the machine is empty the levers are in the position shown in *Fig.* 4. The cylinder ejector lever cam has been carried to the right, motion being conveyed through swinging arm 9 and lever 11 to the long link which is directly fastened to a plunger (not shown) that in turn forces the cylinder from the mandrel. Purpose of the compound levers 9, 10 and 11 is to provide a leverage of varying ratio whereby the cylinder can be started from the mandrel with consider-

able pressure and then ejected with increasing rapidity to reduce any unnecessary travel of the operating lever.

Motor switch 3 is direct-operating, the contact being carried on the end of the plunger which projects from the switch. A toggle action is provided by means of two levers 4 and 6. Switch lever 4 has a hardened cam surface at its lower end which bears against a roller pin on trip lever 6. The switch lever is capable of slight endwise motion resisted by a spring which causes it to snap from one side of the roller pin to the other as trip lever 6 is rotated.

Connection between the cylinder ejector mechanism and the switch is accomplished by means of trip plate 1 which is suitably shaped to engage trip lever 6 and lever 2 that merely is a flexible extension of 6. In this way movement of the ejector mechanism will operate the switch. When a cylinder is placed in the machine the entire mechanism is carried to the left and the switch then can be operated if necessary by hand.

COMPENSATING FOR MISALIGNMENT

DESIGNED to overcome misalignment of the axle and driven shafts, a compensating car axle drive, *Fig.* 5, embodies an idea that possesses possibilities further afield. V-belts *A* contact the flat face axle drive pulley or sheave *B* with their widest face, generally considered the top of the belt. They then pass over idler sheaves *C,* around the V-grooved generator sheave *D* and back over the second idler sheave *E*.

The heart of the drive is the compensator unit *F* on which idlers *C* and *E* are mounted. This device compensates for misalignment and equalizes belt tension when the axle of the car is not parallel with the shaft of generator pulley *D* as the truck swivels on track curves. By providing that the unit *F* is free to swivel around a vertical king pin this compensating action is accomplished. Axle and play is not affected because the belts are free to shift laterally across the face of the flat faced pulley *B*. Medart Co., St. Louis, developed the drive for transmitting power to units such as lighting generators, compressors, air conditioning generators, etc., on rail cars.

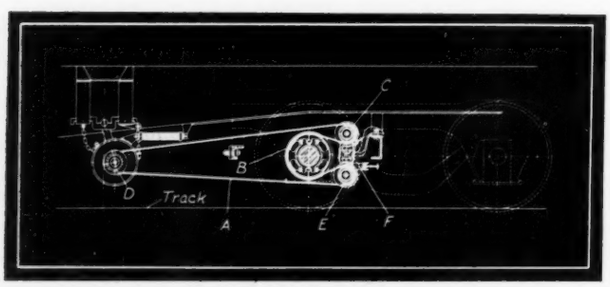


Fig. 5—*Mechanism F embodying two idlers compensates for misalignment of belt drive and equalizes tension*

MAGNETS PRODUCE HEAVY BLOWS

DIRT, dust and grit are important factors to consider in the design of construction machinery. Such machinery must operate under the most severe conditions imaginable, and still be able to deliver heavy work at all times. All these factors were taken into account by Syntron Co. in the design of heavy blow electric tie tamper developed to put more ballast under railroad ties and pack it solidly. By the application of the magnetic principle in the design, only one moving part is required in the unit itself.

The tamper,

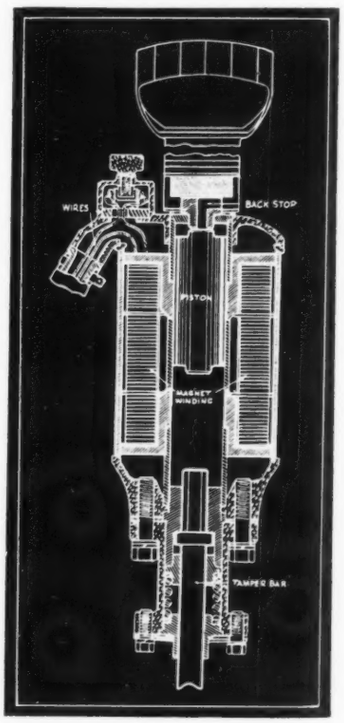


Fig. 6—*This electric tie tamper, operating on the magnetic principle, utilizes a stainless steel liner. As the unit depends for power on the pull of the magnet, not on the fit of the piston, wear does not effect the blow delivered*

Fig. 6, consists of a magnet wound around a barrel containing a free-moving piston. This magnet pulls the piston, up then down at high velocity, the downward pull considerably accelerating the natural gravitational effect of the piston. Longitudinal grooves are machined in the side of the piston to break up eddy currents and to prevent the piston from whirling or rotating. On the down stroke the piston strikes directly on the tamping bar which is retained in the tool by a coil spring. When the tamper bar is in contact with the material it receives the full force of the blow. When the bar is not in contact with the material the spring comes into action. A back stop, cushioned by flat springs built into the head, cushions the up stroke. A special controller built into the power unit provides pulsating current for the magnets.

As the only possible wear in the tamper is between the piston and the cylinder liner, this liner is designed so that it is easily renewable. A stainless steel liner which does not affect the magnetic field is employed.

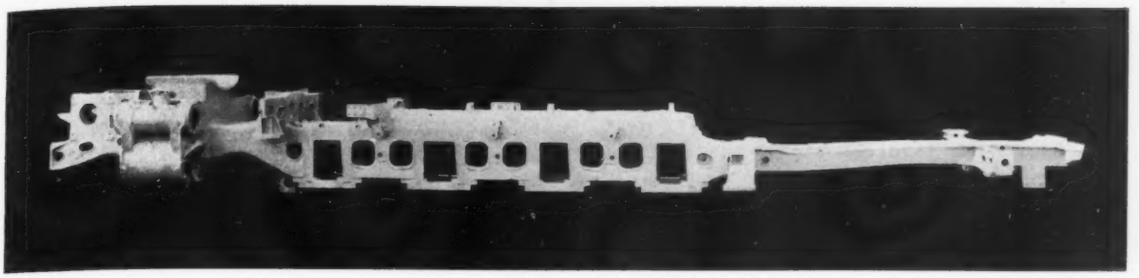


Fig. 1 — Intricate casting resists fatigue and shock stresses of severe service

Specifying Steel Castings for Exacting Service

SINCE the manufacturer and consumer of any commodity must needs have some common ground for discussion of purchased materials, it has come to be the practice to offer specifications on which these purchases are based. These specifications have been drawn always with the object in view of being close enough to protect the purchaser but flexible enough to include the unavoidable variables of manufacturing practice.

Manifestly, new developments in manufacturing practice must precede new specifications and this has been the course in the steel castings industry, according to A. N. Connarroe, National Malleable & Steel Castings Co., who presented the paper from which this article is abstracted at the recent meeting on "Engineering Uses of Modern Cast Metals," jointly sponsored by Western Society of Engineers and the Chicago sections of American Foundrymen's association and American Society of Mechanical Engineers.

Outlines Alloy Effect

The effect of the various alloying elements, available to satisfy these new specifications on the supercooling and transformation rate and the grain size of the austenite offers their advantage in the production of material to meet a predetermined specification. Some of these alloys dissolve in the ferrite matrix to give it additional strength while others form carbides and influence the transformation of the austenite.

Vanadium is a good scavenger and tends to make a cleaner steel. However, its power as a carbide former is its chief function as an alloying agent. The finely divided carbides and possibly oxides exert an intense inhibition upon the grain growth of the steel, probably due to resistance to the migration of the rejected ferrite, thus setting up numerous nuclei for a new grain growth, resulting in a fine grained structure.

Manganese is one of the most powerful carbide formers used in steels. While its chief function is its use as a deoxidizer and sulphur stabilizer, larger proportions perform an alloying action which contributes much to the properties of the metal. The effect of the manganese carbide on the supercooling of the austenite, together with the small solubility of manganese in the ferrite matrix, exerts a powerful effect upon the hardenability of steels. The addition of a small amount of vanadium or molybdenum helps to prevent the inherent tendency of manganese steels to develop a large grain structure and improves the impact strength of the material.

Chromium is most effective as a hardening agent when there is sufficient carbon present to form carbides which influence the split transformation of the austenite. Binary chromium steels have a tendency to be brittle in the ordinary range of carbon and are improved when

TABLE I

Minimum Tensile Properties for Alloy Steel Castings

A.S.T.M. Specification A 148 - 33T

	Tensile Strength	Yield Point	Per Cent Elongation in 2"	Per Cent Reduction of Area
Class A Grade No. 1	75,000	40,000	24	35
Class A Grade No. 2	85,000	53,000	22	35
Class B Grade No. 1	85,000	55,000	22	40
Class B Grade No. 2	90,000	60,000	22	45
Class B Grade No. 3	100,000	65,000	18	30
Class C Grade No. 1	90,000	65,000	20	50
Class C Grade No. 2	120,000	100,000	14	35
Class C Grade No. 3	150,000	125,000	10	25

TABLE II

Physical Properties of Carbon Steel Castings—Per Cent Carbon 0.30

	As Cast	Annealed	Heat Treated
Tensile Strength	74,100	75,000	80,000 - 125,000
Yield Point	37,100	41,500	50,000 - 97,000
% Elongation in 2"	19.5	24.5	30 - 10
% Reduction of Area	31.0	46.2	65 - 20
Brinell	160	145	155 - 250
Izod	16	20	48 15
Endurance Ratio	.40	.44	.50

alloyed with nickel in about the ratio of two and one-half parts of nickel to one of chromium, the nickel exerting a toughening effect upon the ferrite. This combination gives a deep hardening steel which is useful with heavy sections.

Molybdenum exerts a powerful influence upon the transformation points of steel, especially when used with some of the other alloying elements. Deep hardening qualities are produced which require higher drawing temperatures to develop ductility. This promotes the relief of internal strains and renders the material less liable to rupture under sudden stress.

Tungsten has but little influence upon the mechanical properties of mild steels when present in amounts below 1 per cent. In larger amounts it is a carbide former when enough carbon is present for the reaction.

Nickel exerts a depressing effect upon the critical points on cooling, through its alloying with ferrite to produce a fine grained product. Thus it is classed as a toughening agent since the solid solution in the ferrite resists the migration of the carbides during the austenitic transformation.

The great variety of compositions resulting from studies of the alloying elements led to attempts to exploit various privately sponsored products, developing many different requirements for the same material. This resulted finally in the appointment of a committee by the American Society for Testing Materials for the correlation of data and establishment of more uniform specifications.

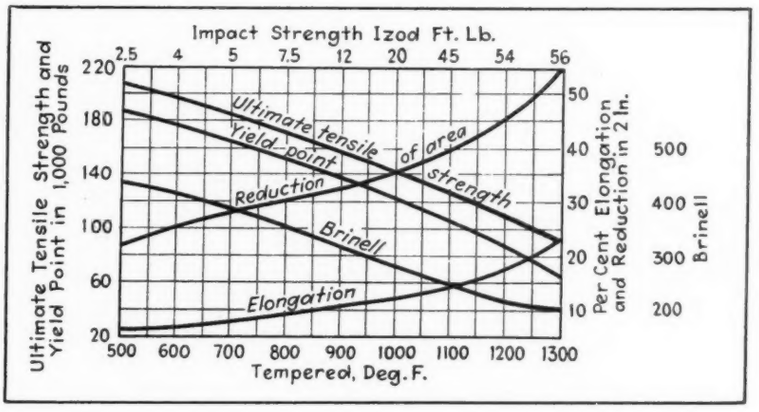


Fig. 2 — Manganese-molybdenum steel castings show excellent results when tempered at about 1000 degrees Fahr.

The new tentative specification for alloy steel castings was adopted in June, 1933, and is known as A 148-33T, "Alloy Steel Castings for Structural Purposes."

Due to the large number of combinations possible with the various alloying agents and to the fact that a great number of good, privately sponsored analyses were on the market, it seemed necessary to include a number of classes and grades and to omit chemical restrictions except a limit of 0.05 per cent for phosphorus and 0.06 per cent for sulphur maximum.

Minimum values were established for each grade for tensile requirements, as listed in TABLE I. Class A covers material, which is so designed that no heat treatment other than a full anneal is applicable.

Class B represents values obtainable by normalizing or full annealing where the material cannot be liquid quenched. A majority of structural alloy steel castings can be subjected to air cooling and high physical qualities are obtainable. Grade 1 of Class B covers steels of the intermediate manganese type. Grade 2 covers intermediate manganese steels with further alloys of nickel, molybdenum, or vanadium. Grade 3 is represented by chrome-nickel, chrome-molybdenum, and chrome-vanadium steels.

Class C applies to castings which are suitable for rapid cooling, as liquid quenching, following by a drawing treatment, and to more highly alloyed material which develops these qualities by normalizing and drawing.

By suitable heat treatments some compositions fit all three classes. However, in this connection it is better not to attempt to get the highest strength possible out of a single combination if the same result can be achieved more easily by an additional alloy.

Combinations of alloys mutually benefit one another and, when properly chosen, may result in a cheaper alloy with superior qualities. This fact is illustrated by the wide use of molybdenum since the war to supplement and partially replace other alloys.

Full annealing of carbon steel castings renders them more ductile and relieves cooling strains making them more resistant to shock. Normalizing and drawing raises the static strength of plain carbon steel castings and helps the impact resistance to a greater degree. Highest static and dynamic strengths are obtainable by suitable liquid quenching and drawing. By

this means the elastic limit is increased about 45 per cent over the annealed condition, the ultimate strength about 25 per cent and the impact value about 100 per cent. Typical values obtainable are shown in TABLE II.

Since but a small part of the latent strength of alloy steel castings is obtainable by full annealing, most of these castings are used in the normalized and drawn condition or the liquid quenched and drawn condition.

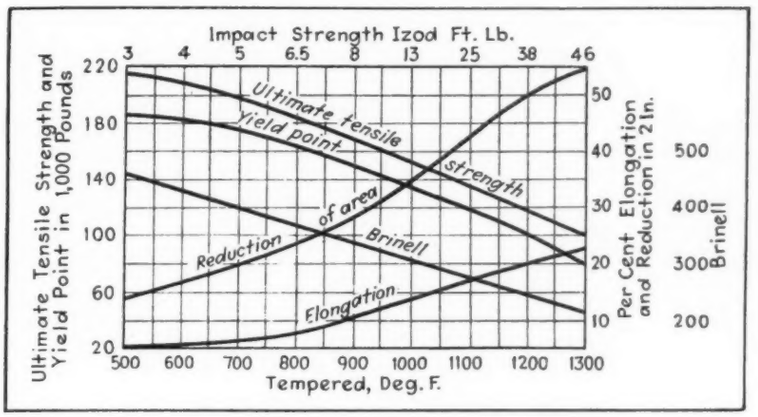


Fig. 3—*Proper tempering of nickel - chromium - molybdenum steel castings is indicated by test results*

Various combinations are used to meet the requirements of each particular case. In making these combinations the resultant effect of the various alloys is produced, the one intensifying or ameliorating the influence of the others.

A widely used combination consists of nickel, chromium and molybdenum, with carbon ranging from .20 to .40 per cent, the amount of the alloying elements decreasing in order. Where chromium steels tend to form columnar grain structures, the addition of about one part nitrogen to 100 parts chromium makes them fine grained.

TABLE III shows results which are being obtained with some combinations with a simple heat treatment. Liquid quenching and drawing would give a wider range of physical qualities with each of them. No attempt has been made to arrange these compositions to fit the various classes, but they represent values which have been obtained in commercial practice and demonstrate how a variety of combinations can meet the same requirements.

Fig. 2 shows results obtainable from a .30 carbon, 1.25 manganese, .30 molybdenum steel, water quenched and drawn at different temperatures. The excellent values obtainable with this composition when tempered at about 1000 degrees Fahr. are shown in this chart.

Fig. 3 shows the result of water quenching a .30 carbon, 2.00 nickel, .80 chromium, .20 molybdenum steel. Again the variations in qualities obtainable by proper tempering are brought out.

It is evident from a study of these two charts that one alloy combination may be made to fit into all three classes of the tentative alloy steel specifications. Where sections are heavy and the castings do not lend themselves to rapid cooling, it may be difficult to reach the specification of Class C.

The rapid rise in impact values obtainable where the alloy composition and heat treatment produce a fine grained structure is noticeable. Impact testing has not been standardized enough to use as a specification but is valuable in the study and development of alloy combinations and heat treatments. The fact that carbon steels fall rapidly in resistance to impact at low temperatures is well known and alloy combinations are being used for service in cold climates very successfully.

After studying the values obtainable with different combinations and heat treatments the section should be designed from a standpoint of ease of castability in the foundry. This will lead to greater savings.

Severe service demands have led to the practice of differentially quenching and tempering castings. By the use of proper quenching fixtures and methods, a marked difference in hardness may be attained in the different sections of the casting so that the wearing parts are hard while the rest is in a machinable condition.

As an example of the possibility of substituting integral castings for fabricated structures is shown the cast locomotive frame, *Fig.* 1. Through the ingenuity of the designing engineer and the foundryman a thoroughly reliable casting has been produced which resists the fatigue and shock stresses of a severe type of service.

TABLE III

Cast Alloy Steels—Normalized and Drawn at 1250 Degrees Fahr.

Kind	Percentages C	Mn	Si	Ni	V	Mo	Cr	Tensile Strength	Yield Point	Per Cent Elongation in 2"	Per Cent Reduction of Area
Ni-V	.26	.97	.30	1.54	.11	.....	.....	90,000	60,500	25.5	50.9
Ni-Mn	.32	1.10	.31	1.10	.....	.....	.....	90,400	63,250	25.0	40.0
Ni-Mo	.33	.70	.....	1.37	.....	.33	.....	91,045	60,536	24.8	54.5
Mn-Mo..	.35	1.35	.....	.....	.....	.35	.....	96,000	68,000	25.5	51.5
Ni-Cr	.35	.80	.40	1.30	.....	.....	.94	102,000	67,400	21.0	41.0
Cr-Mo	.39	.81	.....	.....	.....	.43	.69	103,000	73,000	19.0	40.0
Ni-Cr-Mo	.35	.85	.....	1.75	.....	.35	.75	118,000	90,000	18.0	35.1
Mn-Cr-Ni-Mo	.34	1.58	.....	1.22	.....	.32	.71	125,000	92,000	22.7	51.2

Fig. 1—Accuracy of electric clock is maintained by mechanical spring which bridges over gaps in current

Dual Drive Controls Clock Operation

By Allen F. Clark

FROM their very inception electric clocks have been accepted as the acme of accuracy. Their use on commercial electric light lines subject to abnormal line conditions, might, however, introduce errors that would react unfavorably toward the builders of the clocks and toward the power companies. Therefore it was natural that an electric clock mechanism be designed that would overcome many of the inequalities found in commercial power supply and still maintain an accurate record of the time.

This development, known as the Bichronous movement, *Fig.* 2, designed by Hammond Clock Co., Chicago, not only insures split-second accuracy while the current is on, but also bridges interruptions of current as long as a half to three-quarters of an hour and still maintains the correct time. Thus minor interruptions of current, accidental pulling of the plug or short movements of the clock around the house will not interfere with the accuracy of the time.

The Bichronous motor in the movement consists of a single coil and field frame as in a simple motor, but includes within the field two rotors which may revolve independently of each other. One rotor constitutes a self-starting variable speed induction motor which continually urges the clock to go ahead at an increasing rate. The other rotor constitutes a synchronous brake, holding the speed down to the correct synchronous speed determined by the frequency. Both rotors are mounted on the same shaft, but one is tight, the other loose. After the clock has been running for a short while the speed of both motor and brake become identical and they revolve in unison.

Double Gearing Is Employed

Both motor and brake are connected to the hands through double gearing in which there are two gears on each shaft of the train (one tight, one loose). The whole operates normally as one train and no relative motion between gears occurs. The hands of the clock are connected to the portion of the train controlled by the synchronous brake, while the variable speed motor is connected to the hands through a conventional clock spring enclosed in a revolving barrel, *Fig.* 3.

When the clock is running with the current on, motor and brake revolve together, the motor pulling ahead, the synchronous brake holding back. When the current fails, the motor stops, and the braking effect on the synchronous rotor being removed this rotor starts to speed up. Its speed would increase except for the action of a unique centrifugal governor which takes over the control of the speed and holds the average value of the speed to what it was before by an alternate speeding up and slowing down process which is characteristic to the design of this governor, as discussed in the following.

Energy for running the movement during the current interruption is, of course, derived from the spring. If current is not resumed within the period required for the dissipation of this energy, about forty minutes, the clock stops and

does not start again when the current eventually comes on. The purpose of this is to prevent the clock from being in error, a condition which would exist if it started up again after an interruption of an hour or two.

As the assembly consisting of the synchronous brake rotor and governor is directly geared to the hands, the change-over from electrical to mechanical motivating force does not affect the accuracy of the clock in the slightest degree. The only noticeable difference which occurs when the current is turned off is a clicking sound somewhat louder than the tick of an ordinary clock, which will warn the user that the current is shut off in case he has inadvertently pulled the plug out of the wall socket or has loose connection, etc. This noise stops as soon as the current supply is resumed, and the spring is rewound through action of the motor which speeds up until the balance between brake and motor is again achieved.

The design of the governor is particularly interesting as it operates on a principle somewhat different from conventional centrifugal governors. The ordinary governor would not be accurate enough because it would have some increased speed with increased torque. Also, if it were accurately set for the correct speed it would not permit the clock to run faster when the frequency was temporarily above normal, a necessary condition as the power companies must be allowed a certain leeway for their frequency. If, on the other hand, the governor were set to operate at a higher speed to allow for fluctuations in frequency, the clock would run fast when the current was off.

In the design of the governor, shown at *A* in *Fig.* 3, a small weight is secured on a thin flat steel strip in such a way that this weight will move out radially from the center of the governor a small distance with increasing speed. Outside of the normal trajectory of this weight

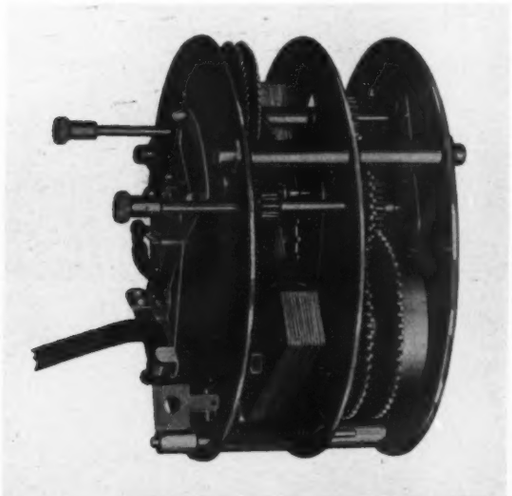


Fig. 2—Two rotors turning in a single coil govern clock operating speed

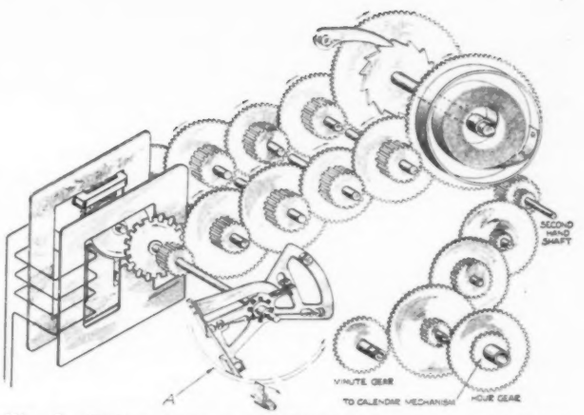


Fig. 3—Unique type of mechanical governor maintains constant average speed despite fluctuations

is a small movable member known as a latch, made of hardened steel and capable of swinging around a pivot if it is struck by the governor.

In a 60-cycle clock with a normal speed of rotation of the governor of 60 units, the governor is so adjusted that it will not strike the latch when running at 60, nor will it do so at speeds of 61, 62, 63 or 64. If, however the governor reaches a speed of around 65, the latch will be struck and will be thrown violently away from the governor. In this impact an instantaneous energy transfer takes place by which the governor is left running at 55, a speed which is as much below the normal speed as the speed was before it struck the latch. The amount of energy transfer is a function of the relative moments of inertia of the governor and of the latch.

As the current is off when the governor is in operation, the synchronous brake no longer works and the governor speed rises immediately to 65. It is then knocked down to 55, rises to 65, etc. While the current is on, the governor never strikes the latch.

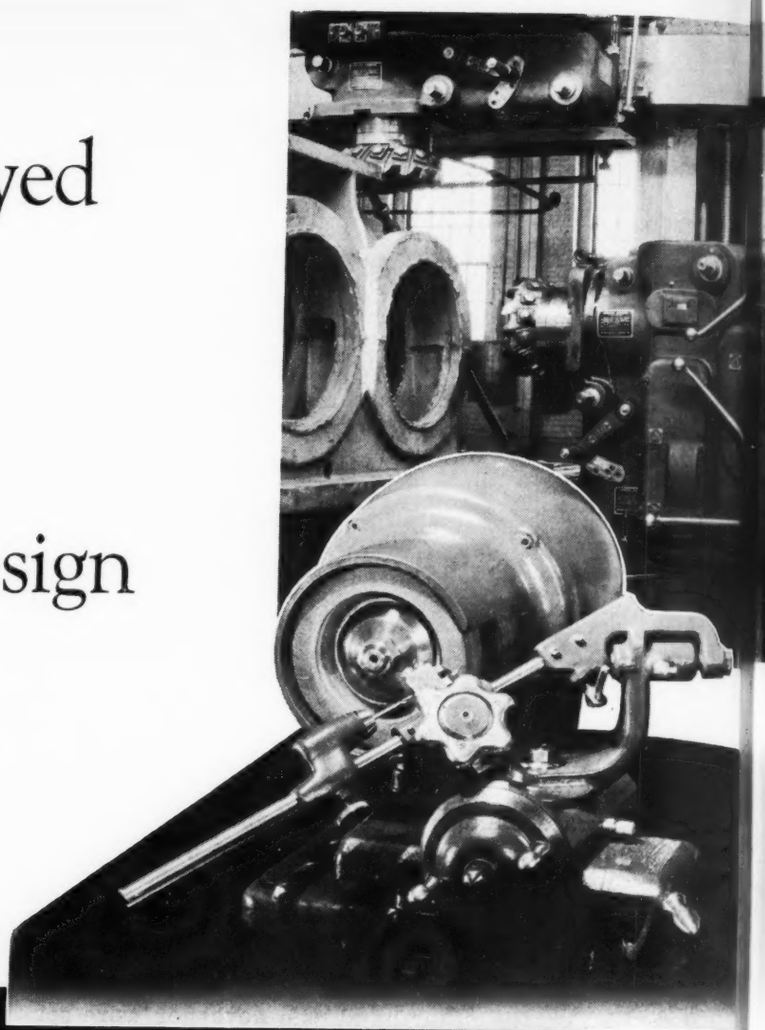
Materials Carefully Tested

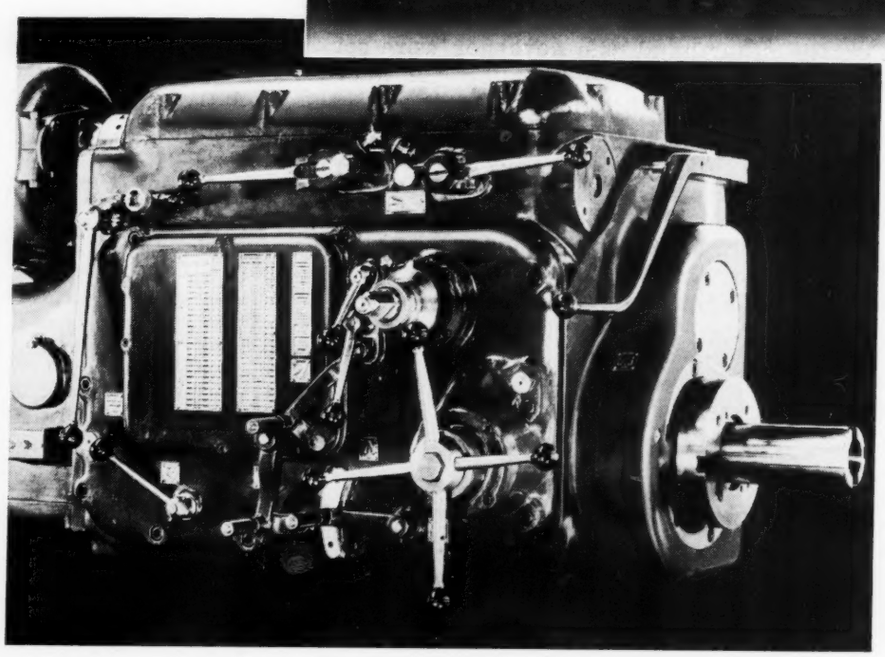
The development of this Bichronous movement was a long one, affording the opportunity of thoroughly testing large number of materials for their suitability for the various purposes. As a result, a nonmagnetic stainless steel (chromium alloy) was adopted for the gears. This alloy, while slightly more expensive than the materials formerly used, is much more resistant to wear of teeth. The pinions which run with these gears are made of hardened carbon steel.

All shafts on which power is transmitted are straight cylinders without shoulders or teeth. This makes it possible to use drill rod which is heat treated and hardened, the surface being ground in centerless grinders and polished. This procedure produces bearings in which one surface is smooth and extremely hard. The other surface is exceedingly soft and elastic, being made of a phenol plastic.

Materials Employed in Modern Machine Tool Design

By B. K. Price





SELECTION of materials for use in the construction of machine tools involves a number of important considerations. Factors such as strength, wearing quality, machinability, resistance to abrasion and corrosion, weight, appearance, hardness, and not infrequently the grain structures must be carefully weighed.

In the designs of William Sellers & Co. Inc., Philadelphia builders of drill and tool grinders, planers, planer-type millers, boring, drilling and milling machines, railroad shop tools and special machines, the problem of selection is further complicated by the varying uses to which the materials must be adapted.

Cast iron usually is selected for the larger elements. It is sufficiently rigid in most cases, provides enough mass to minimize vibration, and yet it enables good appearance. Moreover, it is generally less expensive. Cast and fabricated steel, however, are used for some major sections where strength is of spe-

Fig. 1—(Center)—Careful attention was given to appearance of this drill sharpener, built mainly of cast iron. Fig. 2—(Bottom)—Head for a combination horizontal boring, milling and drilling machine reveals application of a variety of steels, cast iron and other materials

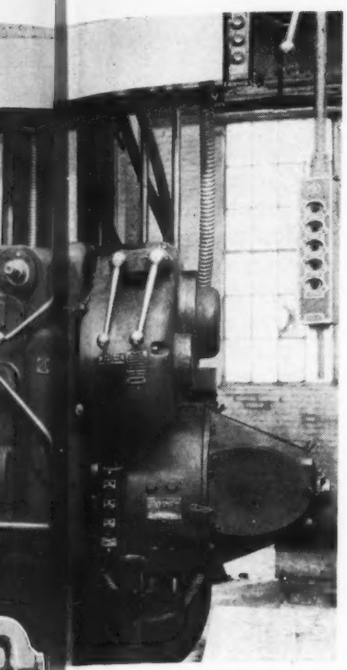


Fig. 3—A variety of materials including ground shafting, cast iron, chrome-nickel-molybdenum steel and stainless steel are employed on head for a planer-type milling machine

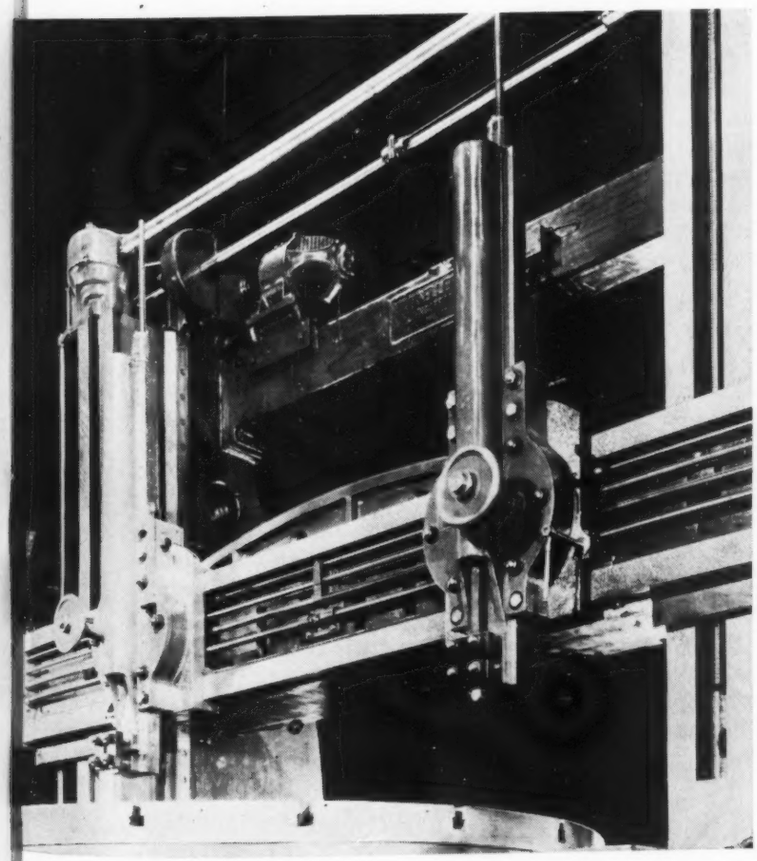
cial importance. For example, cast steel is used for the ram on the company's vertical boring mill because of its greater strength. The cross rail brace on an open-side planer is of steel, but in this case the material, mostly plates, is fabricated by welding. For this purpose three characteristics are desired—strength, rigidity and lightness. Welded steel is also sometimes used, provided there are no casting patterns, for certain simple parts such as motor bases and brackets.

Wherever it is necessary to keep down weight and the strength of the material will satisfy the application, aluminum is used. Certain parts of the overhanging arm on the company's new boring, drilling and milling machine, and the cover on the head, are of aluminum.

In the selection of cast iron, the grade is carefully considered for the work to be performed. For movable parts and those having bearing surfaces, high grade close grain iron is used. The best iron for this purpose is obtained by inclusion of steel as this procedure increases the strength, reduces the graphitic carbon and produces a fine grain.

Types of steel sheets selected for welded structures also vary, depending upon the work. The main portion of the steel used is boiler plate, but for wearing surfaces cromansil (chromium-manganese-silicon) steel, or a steel faced with cast iron plates, is required. Cromansil is particularly desirable as it will go through annealing without losing hardness.

Fig. 4—Cast iron and cast and rolled steel enter into the construction of large boring mill with 16-foot swing



Chrome-Nickel Alloys Specified

As for smaller parts, various materials are specified. For spindles requiring accuracy of size, strength, and resistance to abrasion from chips the company uses nitralloy because its surfaces can be made hard without distortion when properly treated. For spindles not requiring extreme hardness chromium-nickel alloys are specified, particularly chromium-nickel-molybdenum, an alloy which has the quality of being machinable, yet possesses relatively high hardness.

Gears are usually of chrome-nickel alloy, either S.A.E. 3140 or 3250, depending on the service and the strength required. It has always been found preferable from a cost standpoint to use S.A.E. 3140 steel as the heat treatment is completed before machining. Where S.A.E. 3250 steel is used for gears, a normalizing process usually is necessary before the finish machining, and the bore and teeth generally have to be ground after final hardening.

Chromium-nickel steel gears are usually carried on chrome-nickel shafts which may be forged or turned from hot-rolled bars. For shafts of the lower stresses and for long splined shafts and screws, the company selects machinery steel S.A.E. 1035 or 1055. Where a large portion of a shaft is of one diameter, it is economical to buy ground shafting, finished close to size on centerless grinders.

Employs Socket Head Bolts

Nearly all bolts located on machines in positions where they can be seen are of the socket-head type because of their more attractive appearance. The bolts are of alloy steel, hardened —either chrome-nickel or chrome-vanadium. Special bolts, pins and the like require special alloys, according to function.

For shear pins, the company has found by investigation that a chrome-nickel alloy is the most satisfactory. If it is a pull pin to locate a

selection lever it will probably be case hardened to reduce wear. If it is a bolt or nut exposed to action of water on a grinding machine, it will be made of stainless steel—these, to cite a few examples.

Case hardened parts are made of commercial bars, S.A.E. 1112 and 1120, where threads are to be cut, and S.A.E. 1015 steel where the stock is to remain unthreaded. Parts subjected to higher stresses require chrome-nickel S.A.E. 3140 or 3250.

Die Castings Are Employed

Die castings are used in the production of machines where they are required in sufficient quantities to justify the manufacture of dies. In some cases these die castings are chromium-plated to resist the abrasive action of dirt and grit.

Bakelite or some similar composition is used instead of metal on certain machines for high-speed pinions, to reduce noise. Bakelite handles are used on control levers for many of the machines.

All scales, verniers and dials are of stainless steel, so that they will not rust or discolor. Stainless steel castings are used where part of the castings are to be machined and polished to provide a zero line for scale or dial. For counterweight ropes, the company uses plow steel cable because of its flexibility and strength, and sometimes lead for the counterweights where space is limited.

Selects Bronzes for Wearing Quality

Bronzes are selected in most cases for wearing quality, with various grades for different applications. Bushings without excessive unit bearing pressure are satisfactorily made of phosphor bronze; where pressure is high, special alloys are used. Phosphor bronze is satisfactory for many feed nuts, but where nuts and gears are combined the alloy must be selected which will give strength to gear teeth as well as good bearing qualities to the nut. Incidentally, there are many special applications where special alloys have been developed experimentally.

Most modern machine tools have built-in lubricating systems. The Sellers company uses aluminum tubing wherever the system requires constant circulation of oil from the reservoir through a system and back again. In a lubricating system where the oil is fed by gravity or forced through the bearings under pressure and not returned to the tank, either copper or aluminum tubes are used. Selection of lubricants is carefully considered, usually with the assistance of lubricating engineers of one or more of the larger oil companies. Instruction plates attached to various parts, advise the operator where and when to fill and what grades of lubricant to use.

Paint and its application come in for important consideration in the designing of machine tools. For the inside of gear boxes which have been pickled to remove sand, the designers specify a paint that is oilproof and sufficiently hard to withstand shocks of use. This paint acts as a seal on the castings, prevents any loose particles from working out of the pores, and also facilitates the cleaning of the inside of gear boxes when this is desired.

Fig. 1 shows a drill sharpener for handling diameters from 1/16 to ½-inch. Most parts are of cast iron. The motor parts are purchased and built into the machine. Some chuck parts are made of die castings, chromium plated. Parts that actually come in contact with the drill are of hardened tool steel and are replaceable. Incidentally, the paint specifications came in for considerable care, appearance being especially important in a small machine of this type.

Details of Typical Machines

Fig. 2, showing details of the head of the company's new combination horizontal boring, milling and drilling machine, reveals the application of a variety of materials. The head is of cast iron with 30 per cent steel and nickel and has a cover of aluminum. Bakelite knobs may be noted on the ends of the operating levers. Visible also are alloy steel socket-head screws. The micrometer dial is of stainless steel, and the flow indicator of chromium-plated brass. The straight levers are of rolled steel and those with a bend of cast steel.

On this combination machine, chromium nickel steels, S.A.E. 3250 and 3140 are used for the gears, driveshafts and the spindle sleeve, the latter being supported in tapered roller bearings which contain nickel-molybdenum steel in both braces and rollers. Stainless chromium-nickel steel is specified for the table and upright scales.

Housings Are of Cast Iron

Fig. 3 is a 20-horsepower head for a planer-type milling machine equipped with a flange-type motor. The housing and larger parts are all cast iron, while the shafts and screws are made of ground shafting, S.A.E. 1035. The spindle quill is of chrome-nickel-molybdenum steel. Stainless steel is used for the circular scale and for the cover over it. The lubrication instruction plates are of enameled aluminum.

Fig. 4 shows a large boring mill with a 16-foot swing. The main members are of cast iron, while the tool bars (5-foot stroke) are of cast steel. The large circular table gear ring is rolled steel. Sheet metal is used to cover the gearing.

Cold Rolled Steel Effects Design Economies

By Harold B. Veith

SUCCESSFUL design involves more than the conception of an idea. Moreover, the arrangement of parts into a unitary mechanical structure is only the beginning. Granting that the composite of various mechanisms performs its functions perfectly, the designer fails in his objective if he has not considered each phase of the equipment from the standpoint of materials necessary for economical production.

Necessity for close liaison between design and production is well exemplified by the voting machine, *Fig.* 1, produced by the Shoup Voting Machine Corp., at the plant of the Berger Mfg. Co., by virtue of the large number of parts required for each unit. The Shoup machine comprises approximately 17,000 parts. Before it was logical to proceed with the manufacture of the unit the engineering department of the Berger organization worked closely with R. F. Shoup, chief engineer of the voting machine company (and co-inventor with his father) in combining the wide variety of parts into some 150 subassemblies, and these into thirteen major assemblies.

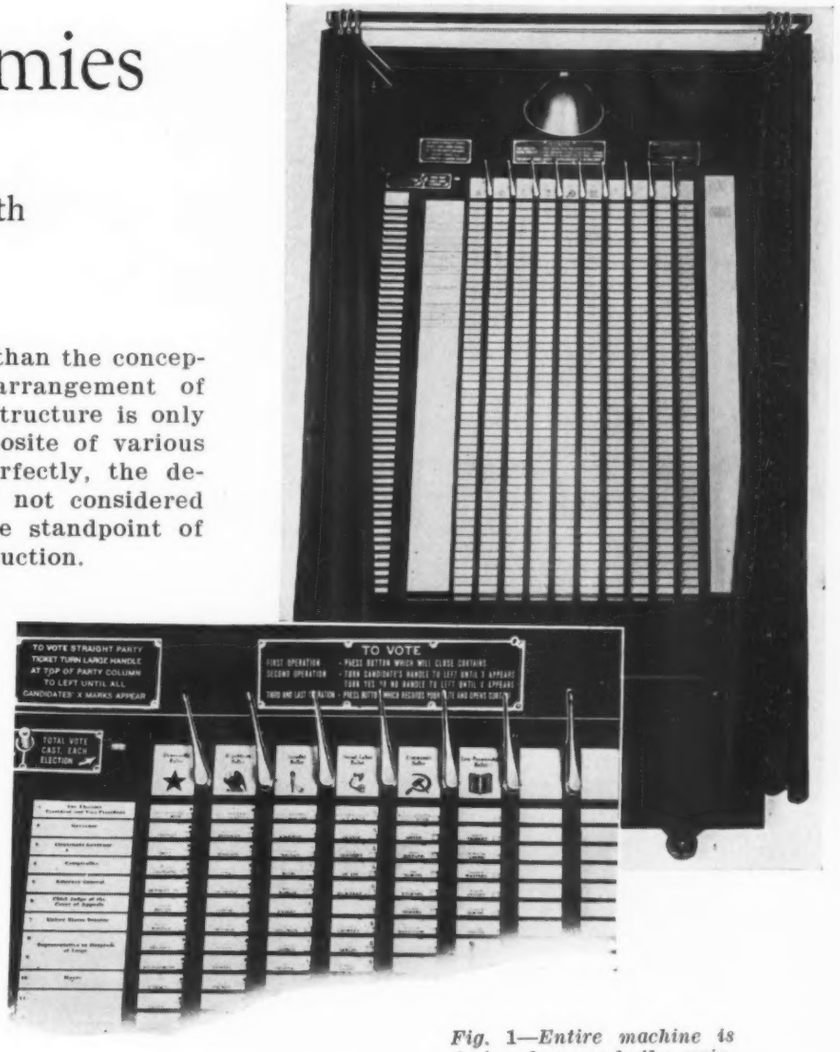


Fig. 1—*Entire machine is designed around the principle employed in the Australian ballot*

A study of production revealed that practically all parts could be made from steel in the form of cold rolled sheet, strip, bars, bands and flat wire. In addition, cold drawn stock for parts produced on screw machines also was employed. All this material is plain carbon steel, excepting that a higher carbon content was selected for some parts subjected to severe wear.

Chassis Is Cold Rolled Sheet Steel

In the actual production of the machine the forming and punching of the center plate is a preliminary step. This member is designed to serve as the foundation of the entire machine and is the chassis on which is mounted all the voting mechanism. Made of 16-gage cold rolled sheet steel, it is produced on a heavy duty power brake.

Because the Australian paper ballot is the form of ballot used almost universally in this country the layout of the candidates' names on the ballot face of the machine follows it as closely as possible, *Fig.* 1. The fundamental difference is that instead of marking the ballot with X marks by pencil, the voter records his vote and produces the marks for his choice of candidates by turning a small lever, one of which is found at each candidate's name. To vote a straight party ticket only one operation is necessary, namely the turning of a large chrome nickel plated handle, one of which is found at the top of each party column. The actuation of

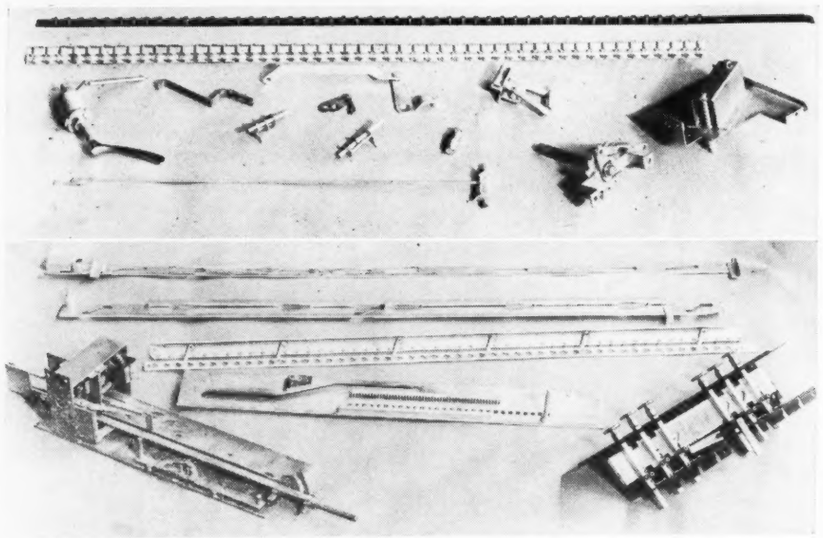
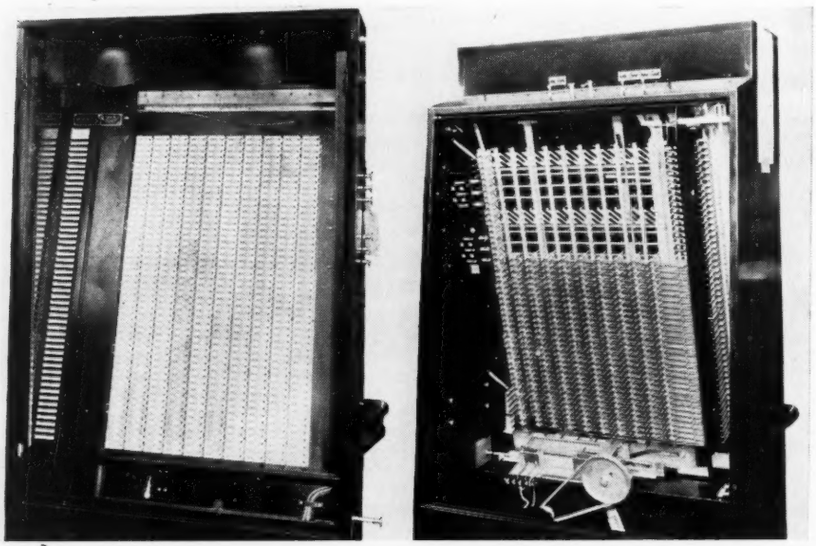


Fig. 2—(Above)—Approximately 17,000 parts have been combined into 150 subassemblies and these into 13 major assemblies

Fig. 3—(Below)—Center plate serves as chassis for the mechanism



this lever causes X marks to appear by each candidate's name in that column.

To protect the mechanism against damage in the event the voter endeavors to force the straight ticket lever beyond its normal stop, a coiled safety spring is employed. The straight ticket lever assembly, shown with the lever attached at the extreme upper left-hand corner of *Fig.* 2, when actuated, causes the vote recording mechanism to operate through the spring which is loaded to 250 pounds. If any attempt is made to turn the lever, to which one end of the spring is attached, beyond the limit of normal operation, excess torque is taken up by the further twisting of the spring.

Opposite each candidate's name is a small lever which is actuated by the voter either in marking a split ticket or when the machine is being used at a primary election. The number of these handles varies according to the capacity of the machine. A nine-party 50-candidate machine, for instance, requires 500 of these small handles—450 for the candidates and 50 for the "Yes" or "No" vote on 25 questions. To reduce machining and facilitate production, cold rolled strip steel was specified. The handles are made in a progressive die in a punch press, one handle being produced per stroke. These handles are placed over the ends of cold drawn square spindles and riveted in place by upsetting the spindle ends.

Strip Steel Utilized

Approximately two inches from each end of these spindles are bearing surfaces, the diameters of which are turned on an automatic screw machine. In working out a bearing to support these spindles, which are positioned in vertical rows in the machine, the designers were able to utilize steel strip. Into the strip, two of which are required for each row of bearings, a series of bearing sockets are punched. These holes or sockets resemble a key hole in contour. The greater diameter of each socket is large enough to slip over the square portion of the corresponding spindle, while the smaller portion of the socket is the same size as the bearing portion of the spindle, and when in position accommodates it. The second strip with the bearing sockets turned 180 degrees from those of the first is installed in the same manner. It will be seen that as the two strips are drawn endwise in opposite directions the smaller portions of the socket holes will act as bearing surfaces for the individual spindles and will retain them securely in their designated position in the machine.

Channels Form Tube

An assembly which fits over the center portion of the square spindle embodies two butterfly stops or lugs that limit the rotation of the spindle so that the handle operated by the voter reaches the end of its travel when the choice of candidate has been recorded. Two channels are

(*Concluded on Page* 52)

Failures of Machine Parts Show Needed Design Changes

By Franklin L. Everett
University of Michigan

A MACHINE part which has failed in service may be a potential gold mine and should be relegated to the junk pile only after all possible information with respect to the reason for the failure has been extracted. The machine designer must receive the benefit of results of investigations of improper practices whether of the nature of metallurgy, fabrication, design, or maintenance.

Failures occur in practice even after the exercise of apparently precautionary measures. Industrial inspection services demand substantial appropriations and still business suffers vast annual expenditures as a result of failures. A weak link in the present system is a disregard for a proper study of parts which are fractured in service. A searching study of the causes of failure should consider the type of loading and the distribution of stresses during the life of the structure. Fatigue resulting from insufficiently large fillets, keyways, shrink fits, and nonhomogeneities in the metal is responsible for numerous important failures in parts subjected to variable stresses. Machine failures which should be carefully analyzed on the basis of stresses are frequently encountered in axles, crankshafts and connecting rods, bolts, springs, etc.

Test Cases Built Up

Test cases of actual breakages may be built up in a manner similar to that employed in the law. Industries will furnish the feeding ground and receive immediate benefit from reports. A qualitative analysis is often sufficient and only the more complicated problems require an exact quantitative investigation.

The need for a systematic study of failed machine parts has prompted the establishment of a group of test cases, some of which are reported in this paper, presented by the author at the recent annual meeting of the American Society of Mechanical Engineers. An analysis of the failures and recommendations for proper design are made on the basis of considering the type of stress condition and the form of the structure.

SEPARATOR TEETH. All of the grain in the threshing

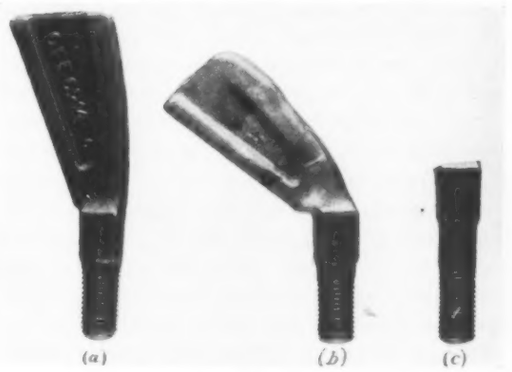


Fig. 1—Teeth subjected to periodic forces may develop fatigue cracks

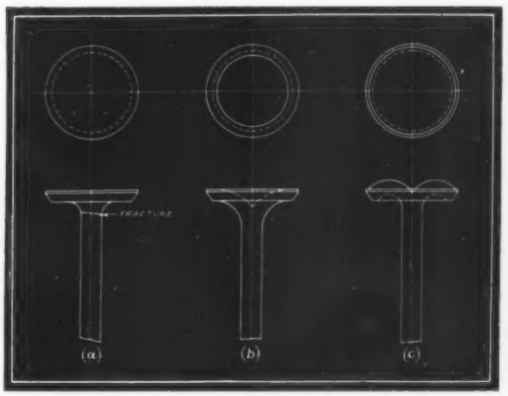


Fig. 2—Many valve breakages result from faulty design

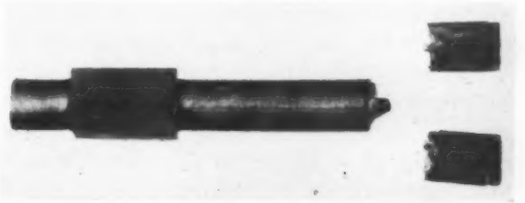


Fig. 3—High stress concentration originates at re-entrant corner

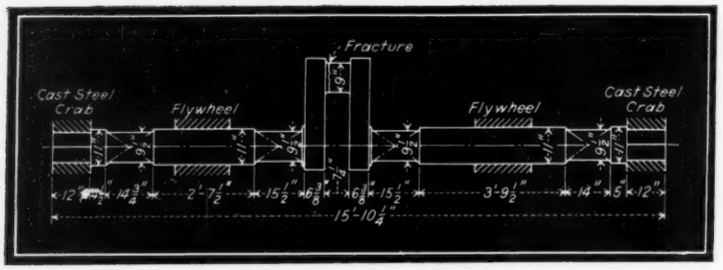


Fig. 4—Jamming of rolling mill causes failure of crankshaft through variable stress and stress concentration

process passes by numerous teeth, some of which are set in a rapidly rotating cylinder while the others are stationary, *Fig.* 1. These teeth are subjected to periodic forces in the direction of travel of the grain, and, because of the stagger construction, the teeth are also bent first to one side and then the other. Frequent failures occur at the junction of the tooth and the bar to which it is attached. The fractured surfaces indicate definitely the presence of fatigue cracks emanating from the front or tension part and from both sides.

The teeth serve as cantilever beams in fatigue with not only a very small cross section at the point of maximum bending moment but with a condition of severe stress concentration. The sharp change of section between the base of the tooth and the bar into which the tooth is bolted provides favorable conditions for the beginning of fatigue cracks. This design can be vastly improved by increasing the section at the base of the tooth in such a way as to provide a flange to discourage such great flexure at the point where the tooth enters the bar.

Flange Maintains Tooth Position

A secondary type of failure which has been observed consists of backward bending of the tooth, as in *Fig.* 1*b*. The presence of a flange to correct the more frequent trouble will assist in maintaining the tooth in its original position.

VALVES. Fractures of valves in automobile and airplane engines which occur during operation often lead to inconvenience and serious trouble. The break usually takes place in the stem or near the base of the fillet joining the valve. A particularly large number of failures of parts in airplane motors are valve breakages, most of which result from faulty design rather than faulty material.

The part of the stem at the small end of the fillet, as shown in *Fig.* 2*a*, is subjected to periodic tension stresses by both direct and bending action. An increase in the radii by the construction as shown in *Fig.* 2*b* and *c* will tend to reduce the number of failures of this kind.

SHAFT WITH WOODRUFF KEYWAY. This shaft is typical of a large number of torsion-fatigue failures resulting from high stress concentration originating at the sharp re-entrant corner of the keyway. *Fig.* 3 shows the main spindle which supported the drum of a washing machine. The load on the shaft pulsated, and the mechanism caused the drum to revolve first in one direction and later in the opposite direction. Such a stress condition may result in a fatigue failure, particularly when prompted by the presence of a sharp-cornered keyway.

As in this instance, fatigue cracks developed gradually from the sharp re-entrant corners of the keyway and spread until the remaining material of the spindle was insufficient to sustain the required load. Final fracture occurred abruptly.

It is interesting to note that shear cracks are evident in both the axial and circumferential directions corresponding with the directions of the maximum shearing stresses.

One would be led to recommend the use of a milling cutter with the corners slightly rounded and a key to fit.

CRANKSHAFT. A fracture of frequent occurrence is that of the crankpin of a crankshaft. *Fig.* 4, a drawing of a crankshaft of a rolling mill engine, serves admirably as an example. The mill jammed frequently, which increased the effect of the reciprocating force applied by the connecting rod on the crankpin. The frac-

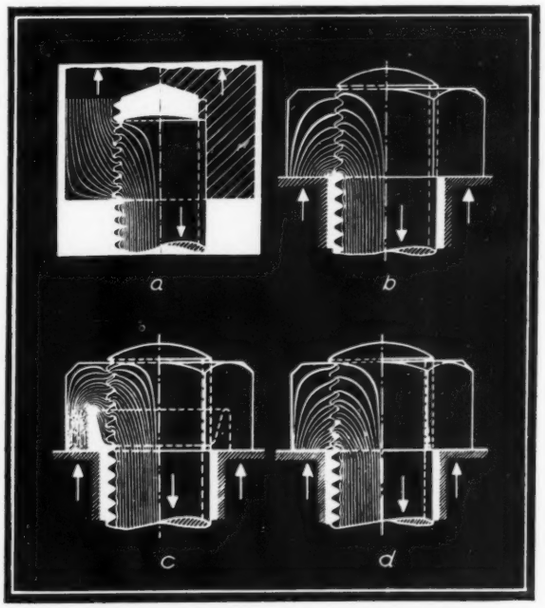


Fig. 5—Radius tends to overcome tendency to fracture near underside of bolt

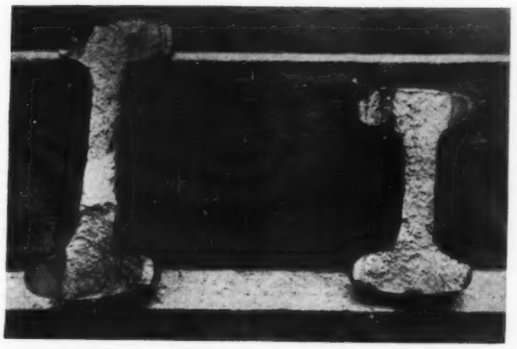


Fig. 6—Forces imposed on connecting rod induce fluctuating stresses

ture at the base of the small fillet of the crankpin resulted finally, after four years of service, from stress concentration and the variable stress.

The remedy prescribed consisted of increasing the diameter of the crankpin on the new crankshaft from 9 to 10 inches. The beneficial effect accomplished by such a revision in design is slight compared with the improvement which might have been made by increasing fillet radius.

Fig. 7—Fastening restrains the spring at the ends and produces a combination of bending stresses

Sometimes undercutting the crank arms will permit a larger fillet.

BOLTS AND NUTS. A tendency for bolts to break in situations which promote fatigue action has demanded study. In instances of fatigue which require special design of bolts, designs as shown in *Fig.* 5*c* and *d* have been advocated. The tendency for the ordinary type of bolt to fracture at the section near the under side of the nut has prompted the new design of a nut which makes the lower part of the nut more flexible. This allows the stress to be re-distributed more evenly along the height of the nut.

CONNECTING ROD. The inertia forces in a large connecting rod, shown in *Fig.* 6, have caused variable stresses during each cycle of operation of the engine. Forces imposed on the connecting rod by the periodic explosion in the cylinder also induce fluctuating stresses, but for heavy rods the forces causing lateral bending must be properly considered. The cross section is an I-beam but apparently is too light to withstand the fatigue action. An analysis of the stresses in such a problem can quite readily be made with only a very moderate amount of experimental information given. The solution is essentially one based on theororetical considerations.

TORSION SPRING. A source of great inconvenience, if not expense, is encountered by the failure of torsion springs at their end fastening. The type of spring shown in *Fig.* 7 is commonly used in the starting mechanism of automobile engines. The spring undergoes a cycle of stressing in torsion each time the mechanism is employed and therefore over a period of time many cycles of alternating stress are imposed.

Combination of Bending Produced

The fastening of the spring restrains the spring at the ends and produces a combination of bending around the two principal axes along with the torsion and tension. The maximum stresses occur very close to the end loop and often produce fracture of the spring.

Fractures would be less common were the moment of inertia more nearly equal around the two principal axes, particularly near the ends where failures now occur. This could be accomplished readily by forging the end more nearly into a square instead of a rectangle.

SHRINK-FIT COLLAR. The broken locomotive-truck axle described here was originally investigated in the usual manner by metallurgists. Later it was found necessary, in order to correct the trouble, to alter the design features. The bending moment in the vicinity of the collars, *Fig.* 8, which were shrunk on to the axles and

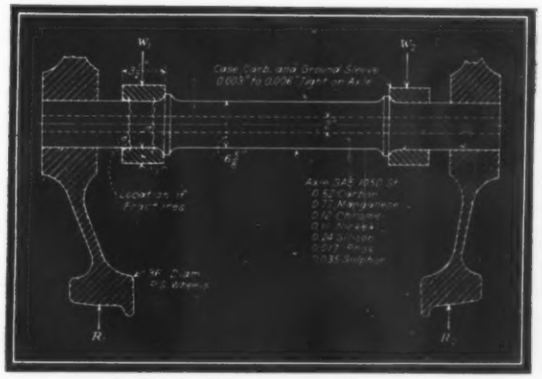


Fig. 8—Sharp change in cross section at collars aggravates high stresses

supported the load, was a maximum. The sharp change in cross section at the side of the collars aggravated the already high stresses so that fatigue cracks ultimately produced fractures at these two sections.

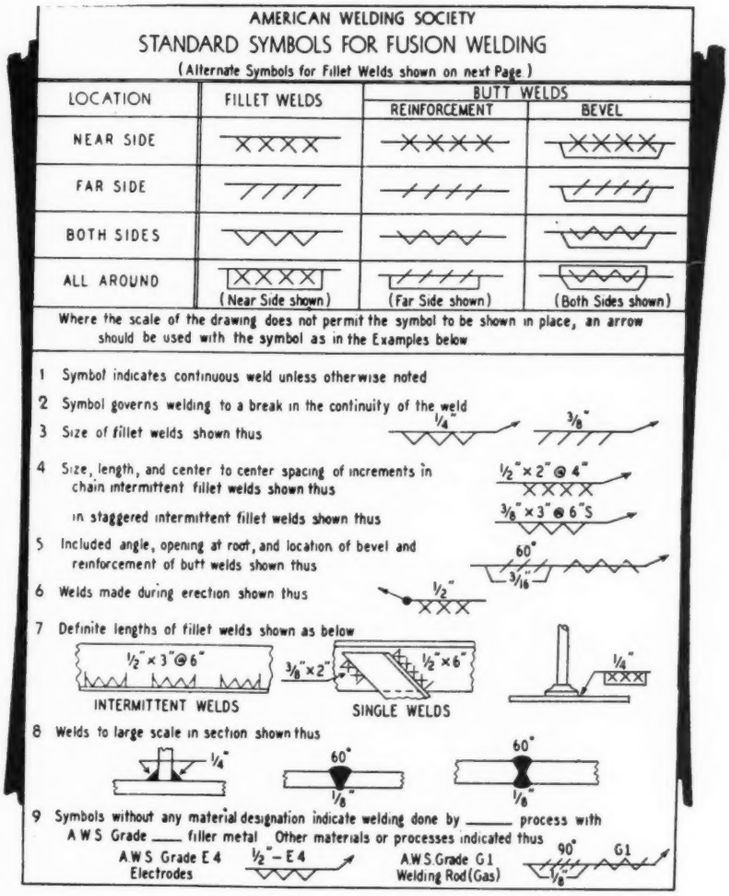
Correction of this difficulty might involve a series of experiments, but it would be reasonable to begin a study to improve this condition by tapering the collars down gradually at each side in a manner similar to that which would be provided by large fillets, i.e., provide flexible ends on the collars.

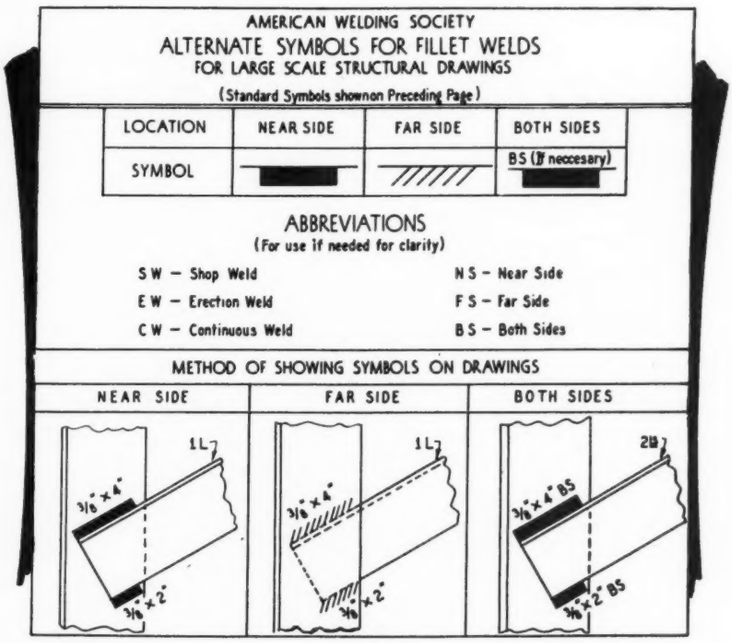
New Drawing Symbols Formulated for Welds

SYMBOLS for use on drawings of all types of structures to be fabricated by fusion welding have recently been revised by the American Welding society. The new symbols, submitted by the committee on nomenclature, definitions and symbols headed by J. W. Owens, Fairbanks, Morse & Co., replace those formerly included in the society's bulletin, "Welding and Cutting Nomenclature, Definitions and Symbols."

Not only have the new symbols been found to be practical as a result of extended use, but they have been adopted as a standard by various bureaus of the United States Navy; the American Marine Standards committee; all of the major merchant shipyards; and a number of machinery manufacturers, steel fabricators, architects and engineers. They have also been incorporated in the Welding society's code for Fusion Welding and Gas Cutting in Building Construction.

Included on the committee revising the symbols were representatives of government bureaus, Westinghouse Electric & Mfg. Co., Air Reduction Sales Co., Metal & Thermit Corp., Electrical Testing Laboratories, McClintic-Marshall Corp., U. S. Steel Corp., Linde Air Products Co., General Electric Co., Newport News Shipbuilding & Dry Dock Co., American Bureau of Welding, Swift Electric Welder Co., and Engineering Societies Library.





New Machines Indicate Design Trends

STREAMLINING in all its phases, from the modified curves of the production machine to the most radical automobile, is exerting a considerable influence on the design of every machine. A survey of recently introduced machines in every field show an ever increasing tendency to build all essential parts completely inside the frame of the machine.

This tendency has developed wider use of machine parts that will adapt themselves to this building in. Compactness is the order of the day and the parts the engineers are seeking are those that will perform the task assigned and yet occupy the least possible space. Materials also are being affected as the designer must have a material that has even greater strength than its predecessors while at the same time supplying this strength with smaller sections.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Agricultural

Grass Clipper,
Krieger Tool & Mfg. Co.,
Wisconsin Rapids, Wis.

Air Conditioning

Car Axle Drive,
Medart Co.,
St. Louis.

Attic Fan Unit,
Air Controls Inc.,
Cleveland.

Bottling

Water Still,
U. S. Bottlers Machinery,
Chicago.

Chemical

Solvent Recovery Still,
Barnstead Still & Sterilizer Co.,
Boston.

Multiple-Hearth Roaster,
Bethlehem Foundry & Machinery Co.,
Bethlehem, Pa.

Hot Acid Pumps,
Bingham Pump Co.,
Portland, Ore.

Construction

Concrete Mixer,
Koehring Co.,
Milwaukee.

Excavator,
Harnischfeger Corp.,
Milwaukee.

Diesel Engine Driven Compressor,
Schramm Inc.,
West Chester, Pa.

Domestic

Ball Top Refrigerators,
General Electric Co.,
Schenectady, N. Y.

Electric Refrigerators,
Norge Corp.,
Detroit.

Ironer,
Landers, Frary & Clark,
New Britain, Conn.

Food

Electric Broiler,
Elsco Appliance Co.,
South Bend, Ind.

Meat Tendering Machine,
American Mine Door Co.,
Canton, O.

Automatic Gas Broiler,
Griswold Mfg. Co.,
Erie, Pa.

Foundry

Tumbling Barrel,
Hartford Steel Ball Co.,
Hartford, Conn.

Molding Machine,
Tabor Manufacturing Co.,
Philadelphia.

Industrial

Filter,
Motor Improvements Inc.,
Newark, N. J.

Ventilating Fan,
International Engineering Inc.,
Dayton, O.

Sound and Motion Picture Projector,
Visomatic Systems Inc.,
New York.

Ventilating Fan,
Meier Electric & Machine Co.,
Indianapolis.

Tank Type Cleaner,
Ideal Commutator Dresser Co.,
Sycamore, Ill.

Metalworking

Automatic Cutting Press,
New Art Specialties Inc.,
Chicago.

Bolt Trimming and Extruding Machine,
Federal Press Co.,
Elkhart, Ind.

Bench Grinder,
Hisey-Wolf Machine Co.,
Cincinnati.

Ball Bearing Buffers,
Baldor Electric Co.,
St. Louis.

Draw-Cut Flash Trimming Machine,
Morton Mfg. Co.,
Muskegon Heights, Mich.

Gear Tooth Chamfering Machine,
W. C. Lipe Inc.,
Syracuse, N. Y.

Office

Automatic Duplicator,
Heyer Corp.,
Chicago.

Automatic Time Stamps,
Acme Recording Devices Corp.,
New York.

Automatic Duplicator,
Rotospeed Co.,
Dayton, O.

Packaging

Barrel Packing Machine,
Sprout, Waldron & Co. Inc.,
Muncy, Pa.

Pipe Lines

Centrifugal Pick-Up Pumping Units,
Byron Jackson Co.,
Berkeley, Calif.

Power

Feedwater Heater,
Elliott Co.,
Jeannette, Pa.

Multistage Blower,
Allen Billmyre Corp.,
New York.

Side Dump Stoker,
Riley Stoker Corp.,
Worcester, Mass.

Printing

Portable Router,
Challenge Machinery Co.,
Grand Haven, Mich.

Quarry

Limestone Pulverizer,
Stover Mfg. & Engine Co.,
Freeport, Ill.

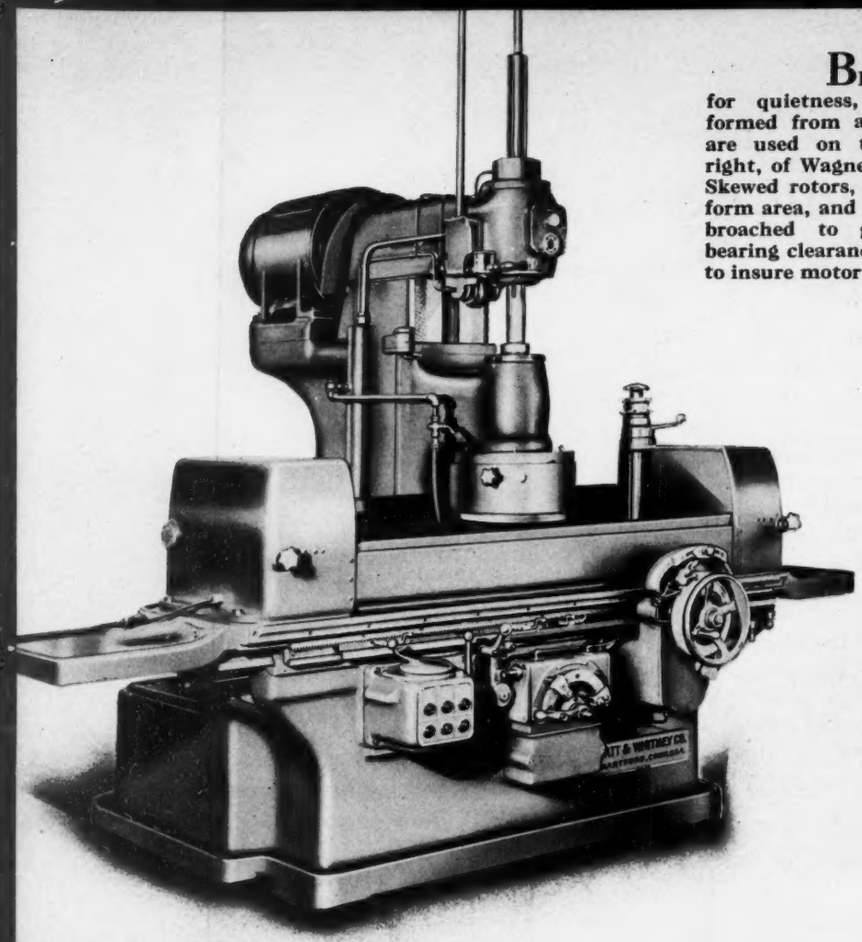
Rubber

Intensive Mixer,
National Engineering Co.,
Chicago.

Textile

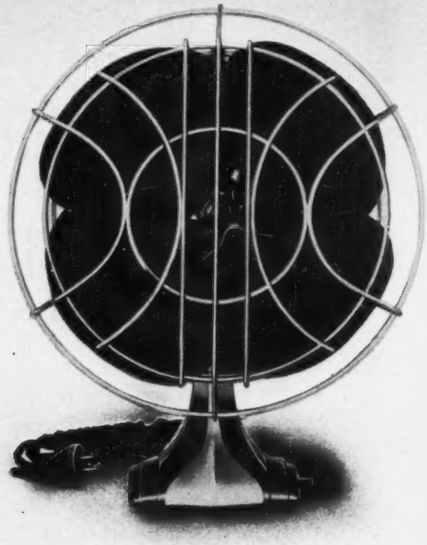
Knitting Machine,
Robacznski Machine Corp.,
Brooklyn, N. Y.

Knitting Machine,
Queens Machine Corp.,
Brooklyn, N. Y.



HYDRAULIC mechanism on vertical surface grinder of Pratt & Whitney Co., above, is driven by a separate motor. Wheel down feed mechanism is the ratchet wheel and pawl type. Control valves are made easily accessible. End play in the spindle is prevented by a series of compression springs which support the upper bearing.

BLADES designed for quietness, punched and formed from aluminum alloy, are used on the styled fan, right, of Wagner Electric Corp. Skewed rotors, air gap of uniform area, and bronze bearings broached to give minimum bearing clearance are employed to insure motor quietness.



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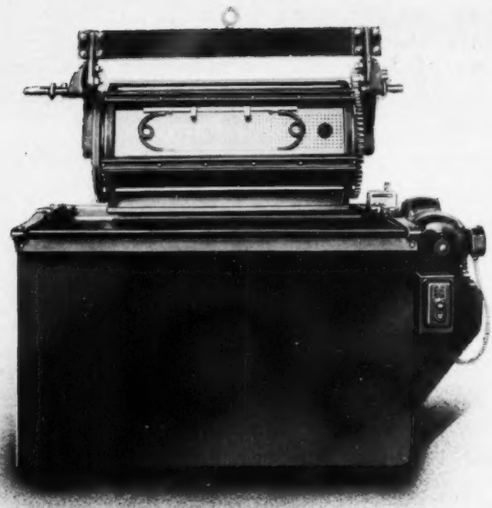
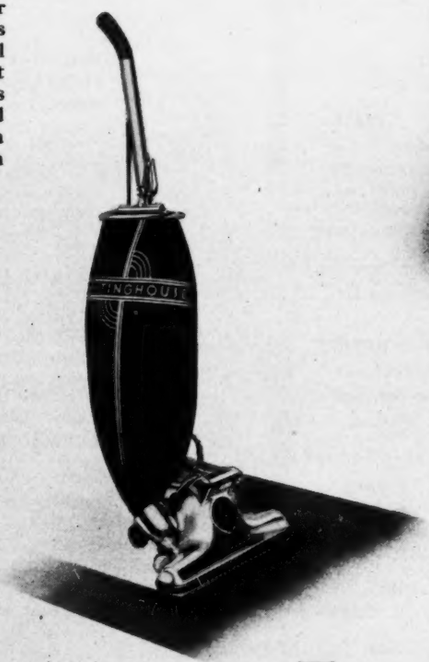
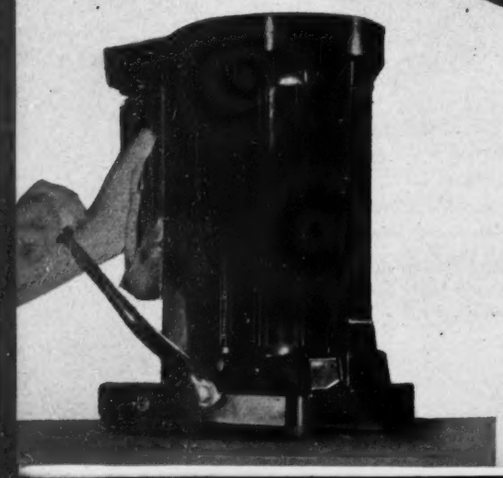


THERMO-CONTROLLED push button switch protects motor of plating barrel, above, against overloading or single phasing. Cylinder of this Udylite Co. machine operates on self-aligning bearings.

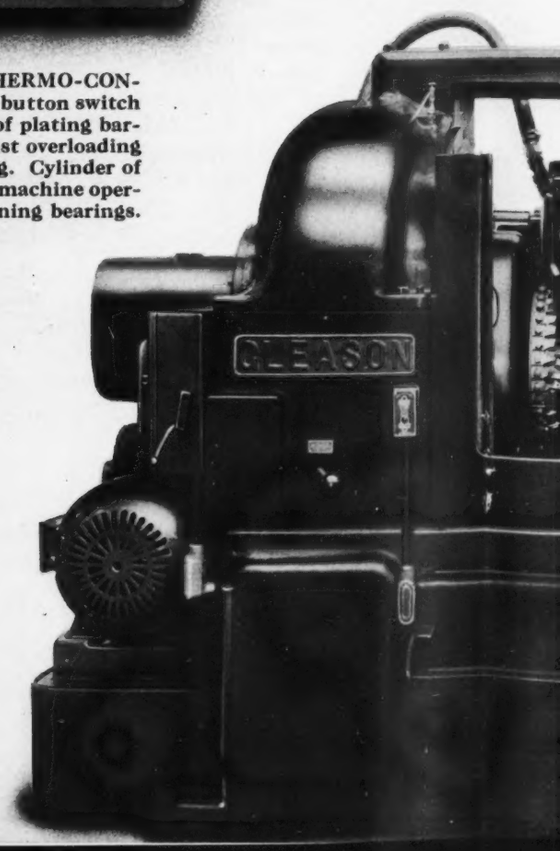


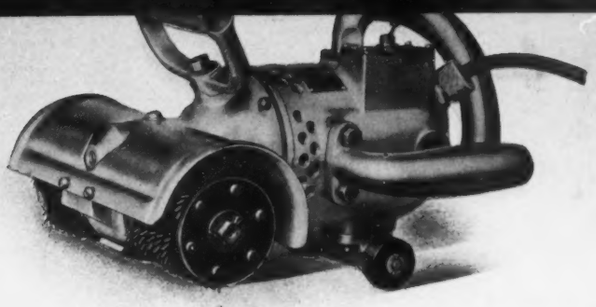
SEALED-TYPE ball bearings and graphite bearings in the wheels are employed for quietness and elimination of need for lubrication on Westinghouse sweeper, right. Brush is driven by a ¼-horsepower motor through a rubber belt. Fan-cooled motor is sealed in to prevent accumulation of dirt on the motor shaft.



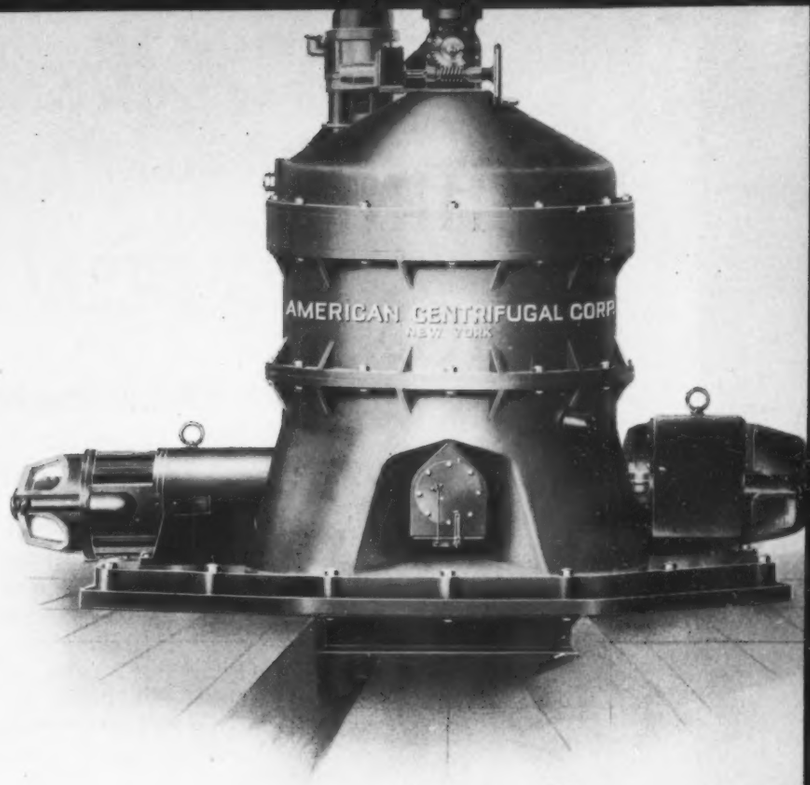
THE MOTOR and all working part of electrical drink mixer and whipper, left, are supported by the three-piece chassis-housing of molded Durez. Molded-in oilless bearings support the high speed shafts. Strain of the geared-up motor is taken by ingenious bearing plates. The machine is built by Andis Products Co.

HYDRAULIC operation replaces complicated mechanical movements in the Gleason Works spiral bevel pinion rougher, right. Short trains of gearing transmit the motion of a pair of reciprocating racks to the cradles and the work spindle.





LOOSE cutters mounted in cutter bundles and thrown out by centrifugal force accomplish the cleaning action in the Berg cleaning tools for removing rust, scale, paints, etc. The unit, above, of Concrete Surfacing Machinery Co., is built of aluminum castings and incorporates a universal motor operating on sealed ball bearings.

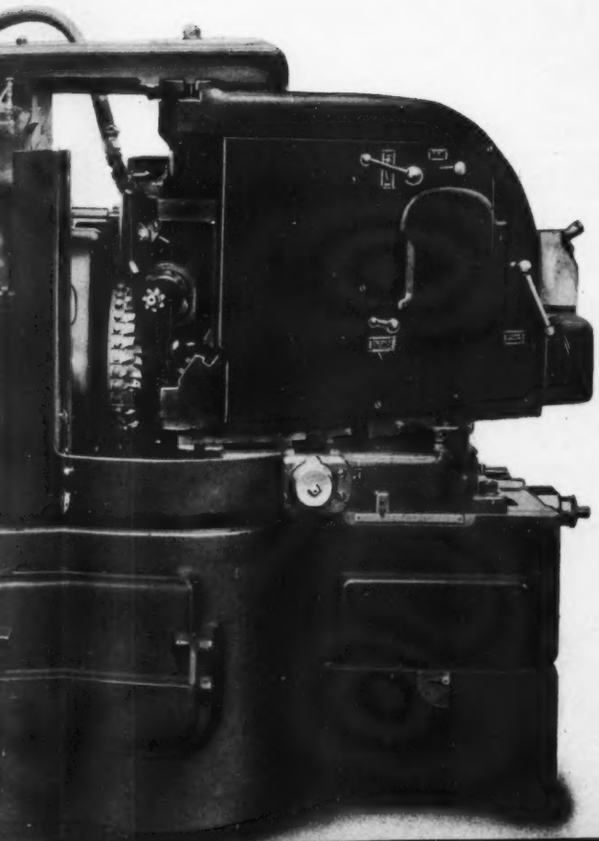


CYCLES of centrifugal for dewatering sludge, above, built by American Centrifugal Corp., are controlled by a telechron clock. The machine was built in three major units to facilitate servicing and insure satisfactory operation. Units are so arranged that incorrect assembly of mating parts is impossible.

Design Features in New Machines

A Pictorial Presentation of Recent Machinery from the Standpoint of Design.

CURRENT control consists of a single adjustment dial on vertical welder, left, of Harnischfeger Corp. A self-stabilized arc is achieved through the use of an unusual internal stabilizer winding. No external stabilizing equipment is used.



COMPLETELY redesigned to make use of modern materials, protect purity of food, and achieve distinctive appearance, the electric meat chopper of Hobart Mfg. Co., right, has a housing which combines molded Bakelite and a nickel-iron alloy, Ni-Resist. Chopper cylinder is of a special alloy, chromium plated.

MACHINE DESIGN

Attainments of Engineers Should Be Accorded Due Recognition

IT IS doubtful whether in any other walk of life, recognition of accomplishment is so difficult to attain as in engineering. To an extent this is due to short-sighted policy on the part of some company managements; to a certain degree to failure of engineering societies to realize and remedy the condition in the past; and partly because individual engineers inherently are not aggressive excepting in their own technical activities.

Fortunately a number of factors are arising that will tend to offset this condition. Among the foremost is state registration or licensing, more than half of the states already having registration laws. Designers of machinery are not necessarily expected to take out licenses, but the fact that many engineers will be recognized by registration undoubtedly will react to the benefit of all members of the profession.

Another agency that should help raise the status of the engineer is the Engineers Council for Professional Development, an organization sponsored jointly by the major engineering societies and allied groups. As Dr. Hirshfeld, chairman of the council, said recently, "The engineer will be recognized in proportion to his ability to serve society broadly and not in a narrow technical sense." Primarily the council is organized to set up higher standards for the profession and thereby to give the engineer, both present and future, a reasonable chance to reach his legitimate level.

Engineers responsible for design, besides taking care of their immediate tasks, owe it to themselves to participate in any professional or ethical movement that will aid in raising their status as a whole.

• • •

Special or Standard?

ONE of the principle assets of the chief engineer or designer is a knowledge of how to take advantage of standard materials and parts. But to keep posted on all the items that are available as standard is not an easy task.

Attention has been drawn recently to a new line of standard bearing mountings that are indicative of the progress that parts manufacturers are making; particularly should such mountings be adaptable to the newer form of welded machine construction, besides offering many short cuts in the design of cast frames. Steel companies in like manner are extending their lines of standard parts for machine construction, numerous shapes formerly considered special now being readily obtainable.

Economy and utility in design demand that alertness be exercised in gathering data on parts that in earlier days were produced singly or in small lots at considerably higher cost.

PROFESSIONAL VIEWPOINTS

Machine Design Welcomes Letters Suitable for Publication

Shafts of Uniform Stress

To the Editor:

THE COMPUTATION of the tapering of a shaft so that the stress due to the bending moment shall be uniform throughout the length of the shaft is a problem of interest to all designers. The nomogram shown on page 42 shows how to compute this tapering, and the contour may then be approximated by stepping the shaft. Shafts of circular section are here considered both as simple and also as cantilever beams with a single concentrated load, the bending moment being a maximum at one point. For a shaft of uniform diameter the maximum fibre stress will be at this point, all other points having lower fibre stresses, which indicates a waste of material.

For a stepped shaft in two bearings with a single concentrated load between them, if d is the figured diameter at load applied l inch from one bearing, then y is the shaft diameter at any other distance x from the center line of that bearing. The relation is $x/l=y^3/d^3$. This gives a cigar-shaped contour included between center lines of bearings. Other considerations determine the shaft diameter at the bearings.

For a shaft extension carrying a concentrated load applied $l = 14.9$ inch from the center line of bearing, at which the shaft diameter is $d = 4.25$ inch, then $y = 2.85$ inch is the shaft diameter at a distance $x = 4.5$ inch from the load. Both the foregoing are computed by the lower pair of index lines.

The actual shaft diameter for a load $p = 8000$ pounds, applied $l = 11$ inches from center line of bearing to produce a fibre stress $s = 6000$ pounds per square inch is given by the upper index lines as $d = 5.31$. This is derived from the equation $d = \sqrt[3]{10.2\ pl/s}$.

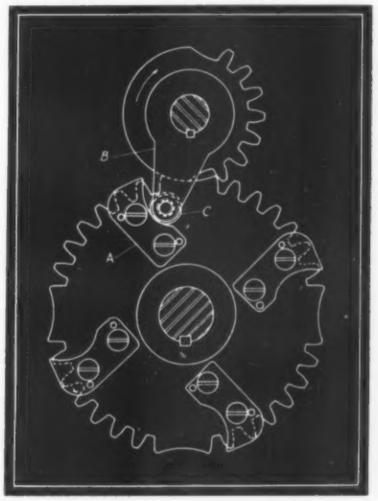
—CARL P. NACHOD,
Nachod & U. S. Signal Co.

Reducing Shock of Gear Impact

To the Editor:

ONE OF the outstanding objections that arise when intermittent gears are contemplated for imparting a rapid movement is the shock of impact at the beginning of each movement. This of course is due to the inadequate meshing of the gear teeth at this point. The difficulty was satisfactorily overcome in one high-speed mechanism by providing the driven gear with cam plates as indicated at *A* in the accompanying illustration. An arm *B* is also mounted adjacent to and keyed to the driving gear shaft. On the end of this arm is roll *C* which engages the cam plates.

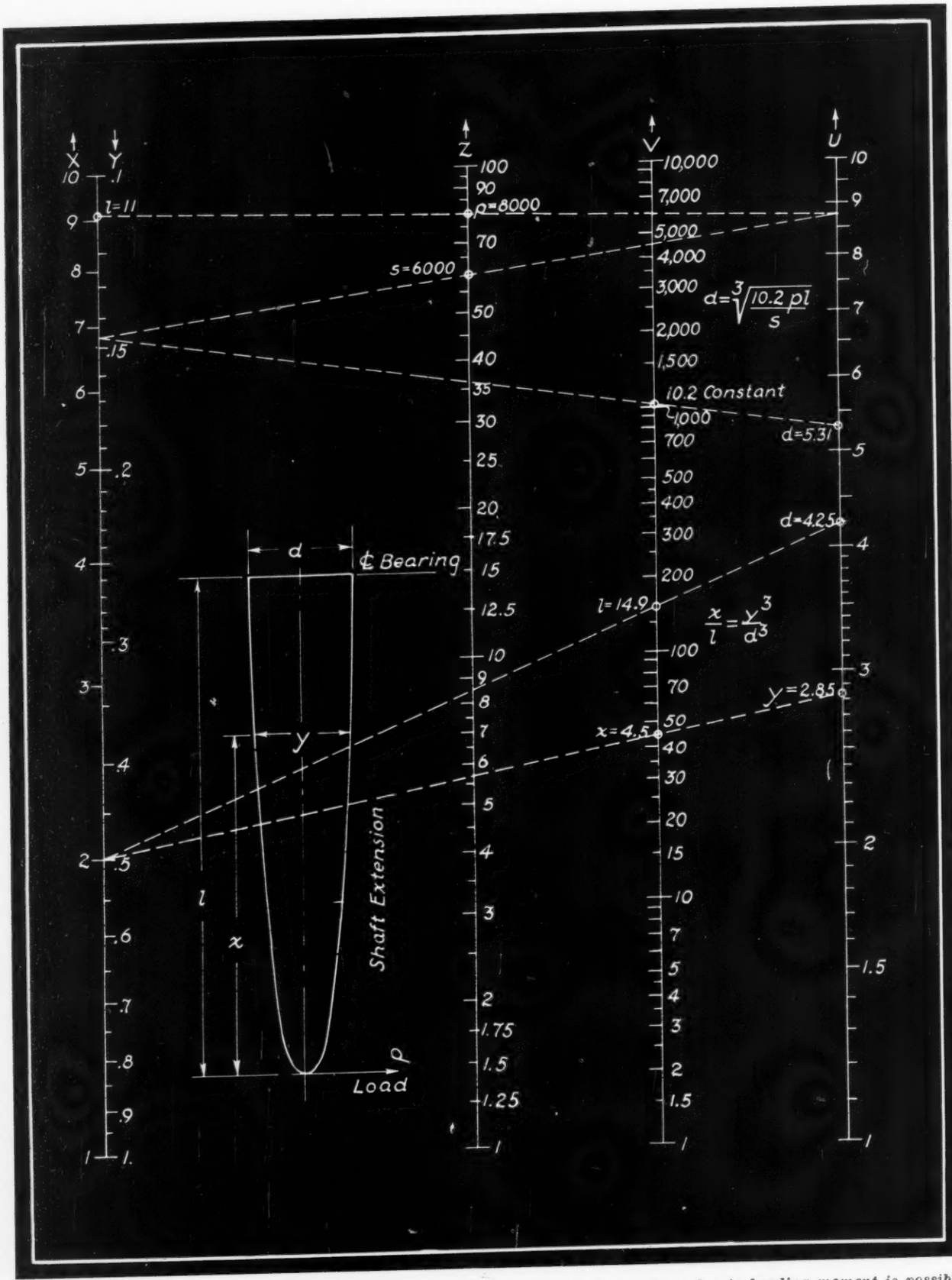
In the position shown, the driving gear at the top is rotating in the direction of the arrow, and its first tooth is about to engage the corner of the first tooth space in the driven gear. However, just before this engagement takes place roll *C* comes into contact with cam plate *A* and gradually starts the rotary movement of the driven gear. In the meantime, the first tooth of the driving gear has moved into full engagement with the tooth space in the driven gear; and at this point the roll, having passed along the entire contour of the cam plate, leaves the latter and allows the driving gear to complete the movement of the driven gear.



Mechanism eases shock of impact of intermittent gears in high-speed devices

One of these cam plates is provided for each movement of the driven gear so that a smooth movement, devoid of shocks, is obtained. Another advantage of this arrangement is that excessive wear on the first tooth is eliminated.

—J. E. FENNO,
Belleville, N. J.



Tapering of shaft to approximate exact contour necessary to insure uniform stress due to bending moment is possible with this nomogram. An explanation of its development and use appears on page 41

MEN OF MACHINES

SCIENTIFIC research on metals and alloys makes progress under the competent direction of such men as Dr. Robert F. Mehl, recipient of the John Scott medal for his discovery of a method of X-raying extreme thicknesses of steel for internal defects.

After finishing Lancaster, Pa., high school, he entered Franklin and Marshall college, obtaining his B. S. degree in 1919. Subsequently he was a graduate student at Princeton and a national research fellow at Harvard, 1925-27. From Sept. 1931, to July, 1932, he served as assistant director, research laboratories, American Rolling Mill Co.

Dr. Mehl's present position is director of the metals research laboratory and professor of metallurgy at Carnegie Institute of Technology. His activities in technical societies are extensive.

ROBERT F. MEHL

• • •

FOR a paper, "Cowling and Cooling of Aircraft Engines," prepared by F. M. Thomas (picture at left) with Rex B. Biesel and A. Lewis MacClain as co-authors, the Society of Automotive Engineers recently awarded these engineers with both the Wright Brothers medal and the Manly medal. This is the first time one paper has attained such a distinction.

Mr. Thomas is a graduate of Massachusetts Institute of Technology and Harvard university. He has been identified with the research division of United Aircraft since 1929, and at present is in England in connection with the introduction of H-S propellers.

Prominent in aircraft circles, Mr. Thomas is a junior member of the S. A. E., an associate fellow of the Royal Aeronautical society and a member of the Institute of Aeronautical Sciences.

F. M. THOMAS

• • •

JOINING the International Harvester organization as assistant to A. W. Scarratt, W. D. Reese recently succeeded him as chief engineer of motor truck engineering. Mr. Scarratt, as noted on page 44 of the March issue, has been advanced to chief engineer over all International automotive engineering activities.

Well known in the motor truck engineering field, Mr. Reese is prominently identified with the Society of Automotive Engineers. At present he is a member of the truck rating committee and the rim committee.

After graduation from Lehigh university in 1916, he became research engineer for Remington Metallic Cartridge Co. From 1917 to 1919 he was in the research department of the Locomobile Co., and subsequently joined the engineering staff of the Fifth

W. D. REESE

Avenue Coach Co. In 1922 Mr. Reese became affiliated with the Yellow Truck & Coach Co., serving as chief engineer of the company's Sleeve Valve Engine Works. Later he joined the Harvester organization, engaging in engineering development work.

* * *

WILLIAM ZORN, formerly welding engineer for Detroit Edison Co., has become consultant welding engineer for the C. H. Dockson Co., Detroit.

* * *

DURREL DAVIS has joined the Spencer Trailer Co., Augusta, Kans., as chief engineer. He formerly was chief engineer for Highway Trailer Co., Edgerton, Wis.

* * *

J. IRVING CORNELL has been appointed chief engineer of the Magnavox Co., Fort Wayne, Ind. He formerly was affiliated with the radio engineering department of General Electric Co.

* * *

GEORGE T. SEABURY has been elected secretary of the Engineers' Council for Professional Development, succeeding C. E. DAVIES, who recently was made secretary of the American Society of Mechanical Engineers.

* * *

M. L. ECKMAN has been appointed to head the research and development department of the Thomson-Gibb Electric Welding Co., Lynn, Mass. He formerly was affiliated with Federal Machine & Welding Co. as engineer.

* * *

WILLIAM B. MAYO, formerly chief engineer of Ford Motor Co. and widely known for other engineering activities, has entered a new field as president of Zonolite Corp. of America, manufacturer of insulating material.

* * *

H. W. GILLETT has been appointed to represent the American Society for Testing Materials on the division of engineering and industrial research of the National Research council.

* * *

C. T. GREENIDGE has joined the technical staff of Battelle Memorial institute, Columbus, O. He formerly was a research metallurgist with A. O. Smith Corp.

* * *

CHARLES H. CHATFIELD, chairman of the technical advisory committee of United Aircraft Corp., has been elected a vice president of the Society of Automotive Engineers.

* * *

CHARLES F. KETTERING, director of research for General Motors, has been appointed to membership on the international board of judges of the Fisher Body Craftman's Guild.

* * *

ARVID LUNDQUIST, for several years engineer in charge of the research and development department of R. Hoe & Co. Inc., recently became associated with the Sylvania Industrial Corp., Fredericksburg, Va., as chief development engineer.

* * *

DR. A. A. POTTER, dean of engineering at Purdue, DR. KARL T. COMPTON, president of Massachusetts Institute of Technology, and DR. HAROLD G. MOULTON, president of Brookings Institution in Washington, have been named members of the research advisory board of the Association of American Railways. L. W. WALLACE, vice president of W. S. Lee Engineering Corp., has been appointed director of equipment research.

* * *

C. K. SKINNER has been appointed designing engineer of the home laundry equipment section, General Electric Co.

* * *

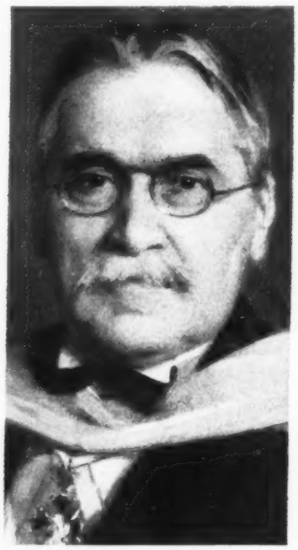
DR. ERNST F. W. ALEXANDERSON, General Electric consulting engineer noted for his contributions to radio, has been elected to membership in the Royal Academy of Science of Sweden.

* * *

EDGAR C. BAIN recently was appointed assistant to the vice president in charge of metallurgy and research of United States Steel Co. He formerly was associated with the Steel Corporation's central research laboratories at Kearney, N. J.

Obituaries

SCIENCE lost one of its most noted exponents in the recent death of Prof. Michael I. Pupin, world-famed inventor. His career as outlined in the Jan., 1932, issue of MACHINE DESIGN, was replete with technical achievements, particularly in wireless and long distance telephony. Once a Hungarian peasant, he was born in the little village of Idvor, Banat, then a province of Hungary and now a part of Yugoslavia. He seemed destined to herd cattle, but dissatisfaction with conditions brought him to America at the age of 16.



Penniless, he found work as a farm hand. Later he worked his way through Columbia college, from which he was graduated as president of his class in 1883. Prof. Pupin was an eager student and his thirst for knowledge carried him to Cambridge and the University of Berlin. In 1889 he received a Ph. D. degree from the German institution.

Many honors for his scientific work were bestowed upon him in the form of medals. Prof. Pupin was author of numerous technical monographs and wrote an autobiography, "From Immigrant to Inventor." His name will live in the annals of technology.

* * *

FRED C. THOMPSON, vice president of Morse Chain Co., died recently at the age of fifty-one. He began his career as a draftsman with Westinghouse. In the early days of the automotive industry he was chief engineer of the Lozier Motor Co. Many of his inventions now are in use.

TOPICS

THE "big push" in the air conditioning industry is on. With three years of "missionary" work completed, manufacturers now are preparing to use trained crews in their sales drives. The success which has characterized mechanical refrigeration is expected to be duplicated by employing similar tactics in developing public acceptance of air conditioning. This type of equipment is expected to move into the volume field this year, an increase of 20 to 30 per cent over 1934 sales being anticipated.

* * *

Machine-made homes gradually are becoming machines themselves, as indicated in an announcement made recently by Houses Inc., New York. The houses are sold complete, "ready to run." Included in the structural unit are air conditioning, built-in radio, built-in electric refrigerator, built-in electric clock, etc. In the center of the house recently exhibited is the "domestic moto-unit," a center column in which are located all plumbing inlets, air conditioning apparatus, and furnace.

* * *

Copper, oldest of the metals of commerce, is being employed today for a wide variety of new uses, thereby increasing its consumption in fields heretofore held largely by other materials. Where a white or satin finish is desired chromium can readily be utilized on a base of copper or its alloys. This procedure is employed by one of the larger oil companies in finishing gasoline pumps.

* * *

Pressure vessel problems in the petroleum industry, particularly in petroleum refining where relatively high pressures, high temperatures and severe corrosion frequently are met, are such as to require special consideration. In order to provide a uniform basis for the construction and maintenance of unfired vessels used in this field, and at the same time not to disturb the uniformity brought about by codes developed by the A.S.M.E. boiler code committee, a joint committee of the American Petroleum institute and American Society of Mechanical Engineers was organized. This joint A.P.I.-A.S.M.E. committee on unfired pressure vessels has completed the first edition of its code for unfired pressure vessels for petroleum liquids and gases, which can be obtained from the A. S. M. E., 29 West Thirty-ninth street, New York.

* * *

The largest single order for steel mill bearings ever placed in any country in the world was received recently by Timken. This fact was brought out in connection with the order for the new Zaporojstal steel mill for the U.S.S.R. which Armtorg Trading Corp. placed with United Engineering & Foundry Co. The order amounts to more than $3,000,000.

The Russian plant is designed to have a yearly capacity of 600,000 metric tons of hot and cold strip up to 60 inches wide. It is estimated that approximately 1500 bearings weighing around 200 tons will be required for this mill.

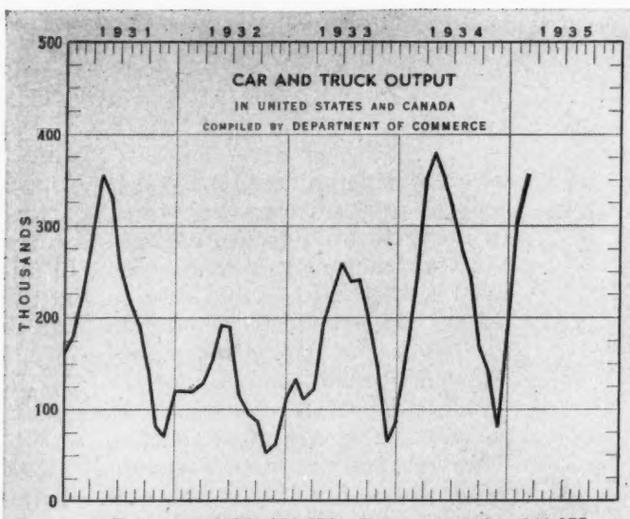
* * *

Joint approval of the Engineers' Council for Professional Development as the agency for accrediting engineering colleges was concurred in by the American Institute of Electrical Engineers recently. Thus was completed the authorizations needed to inaugurate the accrediting procedure which already had been approved by the other participating bodies.

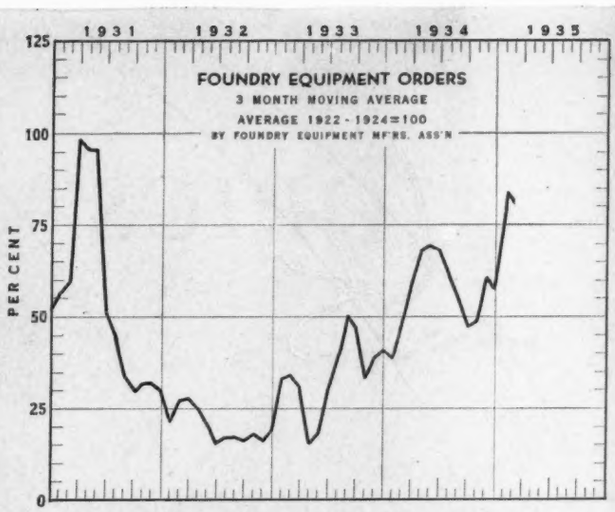
* * *

Now that Dr. George L. Clark, noted Illinois university X-ray specialist in industrial applications, has found that the molecular weight of rubber is 500,000, synthetic rubber may soon be a reality. It is said that synthetic rubber cannot be made unless the molecular weight is known.

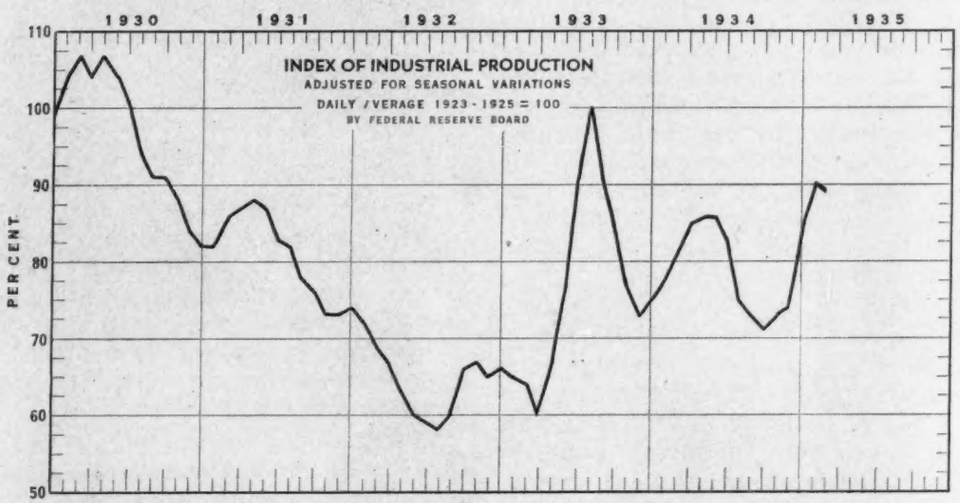
How Is Business?



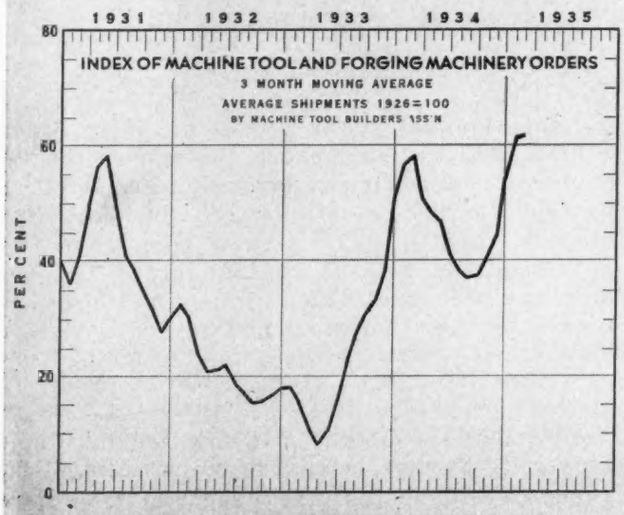
February 1935, 358,658—*February* 1934, 240,278



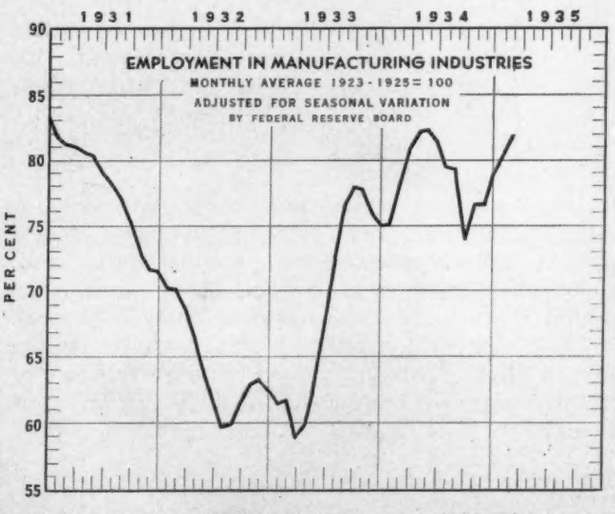
February 1935, 76.4—*February* 1934, 48.9



February 1935, 89—*February* 1934, 81



February 1935, 61.5—*February* 1934, 58.2



February 1935, 81.9—*February* 1934, 78.4

NOTEWORTHY PATENTS

SPRAYED metal coatings (M. D., Feb. P. 28) are applied by such devices as that recently patented by Charles Boyden for Metallizing Corp. of America. This gun, *Fig.* 1, *A*, is designed for fusing, spraying and projecting fusible material supplied in rod form, by means of

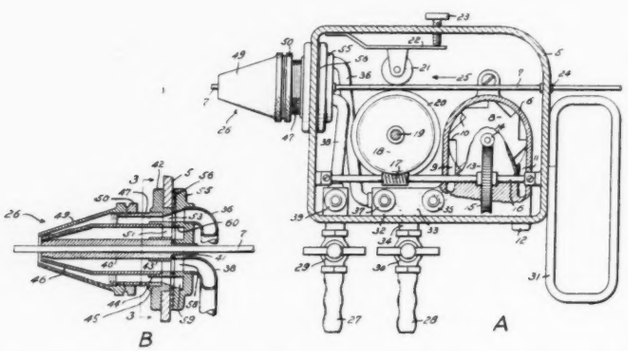


Fig. 1—*Metal enters gun in rod form, is fed into a gas flame and then is projected by air blast*

combustible gas and an air blast. The automatic feeding mechanism is driven by an air motor 6 (at the right in drawing *A*).

Because the air motor operates at high speed it is necessary to employ reduction gearing. A worm gear 14 on the rotor shaft meshes with gear 15 mounted on shaft 16 which carries worm 17 that drives gear 18 on shaft 19. On the latter shaft there is also mounted a knurled wheel 20 which engages and feeds the metallic rod 7 at a low continuous rate of progression into the gas flame at the end of nozzle 26. In order to effect a positive drive a roller 21 carried on stiff spring 22 is provided. Thumb screw 23 bears against the free end of spring 22 and affords a convenient means for resiliently pressing roller 21 against fusible rod 7.

Nozzle 26 is designed for fusing rod 7 by means of a high temperature gas flame and thereafter spraying it upon the surface to be coated. Combustible gas is led to the burner through pipe 38, the flow being regulated by screw valve 39. The burner construction comprises a central tubular member 40, *Fig.* 1, *B*, through which rod 7 is conducted. Gas supply 38 passes through fitting 55 and communicates with annular channels 58; air supply pipe 36 similarly communicates with annular channel 59.

A feature of the equipment is the independent regulation of the air supply to the burner and air motor. Motor inlet passage 9, *Fig.* 1, *A*, communicates with chamber 33 and the flow therethrough to the motor is regulated by screw valve 35. The air pipe 36 leading to the burner also communicates with chamber 33 and the flow is regulated by valve 37.

No. 1,968,815 identifies the patent.

INTERMITTENT motion is produced by a mechanism, a refinement of the geneva, recently granted a patent assigned to Continental Can Co. Inc. One object of the invention is to provide a means for imparting rotation to a driven wheel having radial slots, into and out of which the driving member moves. The latter is so constructed and operated as to give the rotated wheel a relatively quick starting movement and a slow stopping movement.

In *Fig.* 2 top plan view *A* shows roll 32 which is mounted at one end of pin 33, as having entered radial slot 14 and as having started the driven wheel 11 on its intermittent rotation. Inasmuch as there is also a roll at the other end of pin 33 which runs in cam track 35, roll 32 will be moved in respect to arm 27 inwardly toward the center of rotation of the arm. This is of course due to bracket 28 pivoting at point 29.

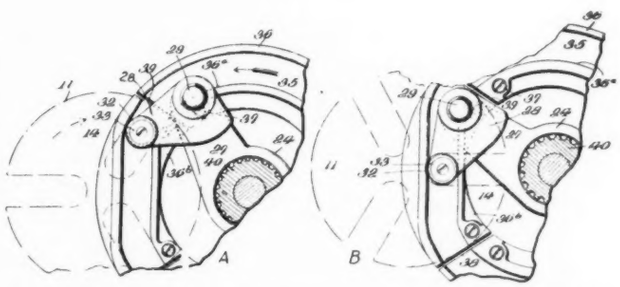
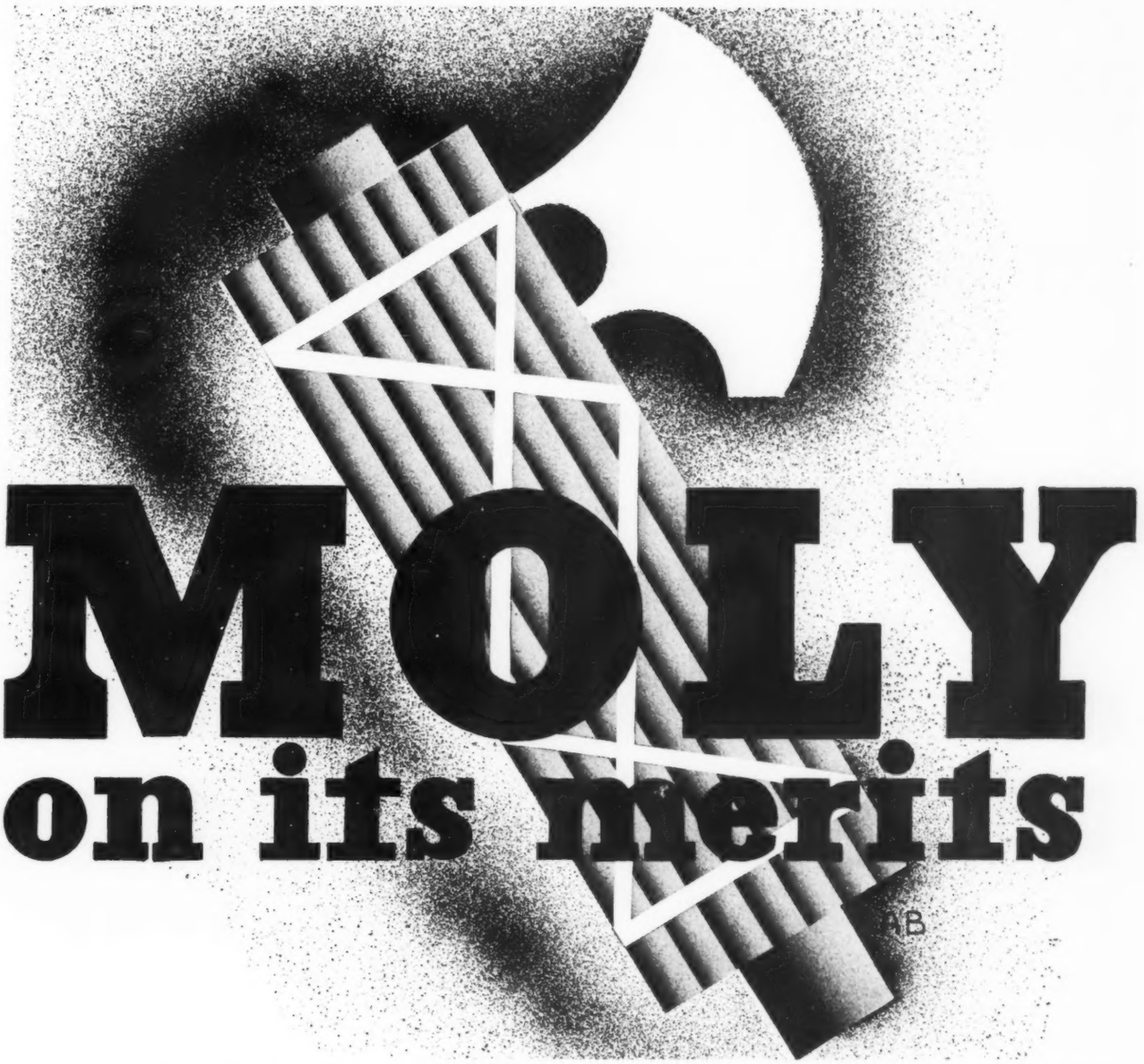


Fig. 2—*A cam track is employed as a refinement to this geneva-type mechanism, for starting and stopping*

Because the roll at the same time is moving in toward the center of rotation of the driven wheel it is accelerating or increasing the angular speed of the driven wheel through its action on slot 14. Thus the driven wheel is started relatively quickly.

When roll 32 reaches the position shown in *B*, the maximum acceleration is being given to the



WHEN a user wishes steel for any particular application, he considers the physical properties which the steel must have. He usually has a choice of several steels. The consideration then quite logically narrows down to the *most economical* steel with which to meet the requirements.

For practically every known application, a Molybdenum-containing steel is available which is more economical than any other type of alloy steel. A broad claim? Yes. But a claim that is based, not on laboratory tests alone, not on isolated instances of practice — but invariably on repeated proofs in manufacture and in service . . . *on the merits* and general recognition of Molybdenum's outstanding qualities.

With "Moly" having, in the past few years, so broadly affected costs and service standards, it is a wise move of the manufacturer of alloy-steel products or the user of alloy-steel equipment and tools, to review his requirements; to consult the Climax engineers; and to learn for himself how money can be saved by standardizing on the more economical Molybdenum-containing steel having physical properties at least equal to what he is now using.

Continual Molybdenum developments have led to the publication of our house organ, *"The Moly Matrix."* A word from you puts you on our mailing list. A further request brings you these interesting books: *"Molybdenum in* 1934" and *"Molybdenum in Cast Iron* — 1934 *Supplement."* And for any alloy problem peculiar to your business, the services of our metallurgists and Detroit experimental laboratory are open to you. Climax Molybdenum Company, 500 Fifth Avenue, New York City. (In Canada: Railway & Power Engineering Corp., Ltd.)

CLIMAX Mo-lyb-den-um

driven wheel 11. From this point on the roll 32 will be moved outward away from the center of rotation of arm 27, and the driven wheel will be brought to a gradual stop due to contour of cam 35 and the normal operation of a driving roll moving in a relatively circular path.

Otto A. Schmitt is the inventor of the device which has been granted patent No. 1,983,570.

BALANCING of rotatable members and improvements in adjustable weights are covered by patent No. 1,980,693, assigned to Wagner Electric Corp. This balancing device is economical to manufacture, easily and permanently attached, and occupies a minimum of space.

In *Fig.* 3, *A,* is shown the device employed for balancing a squirrel cage rotor of a dynamo electric machine. Each end plate 4 is provided with annularly positioned projections 6 upon

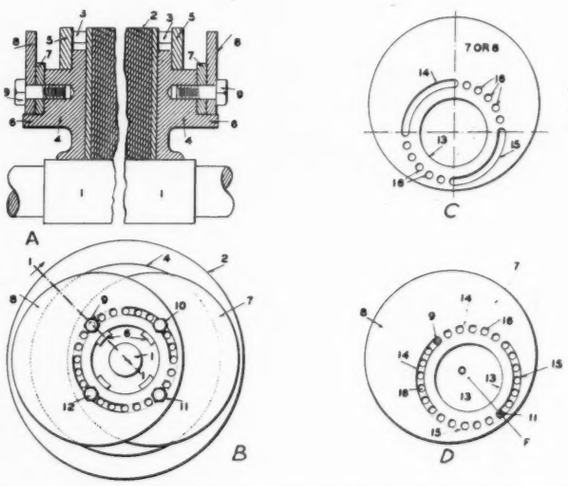


Fig. 3—Weights that are adjustable in their mountings provide an improved balancing device

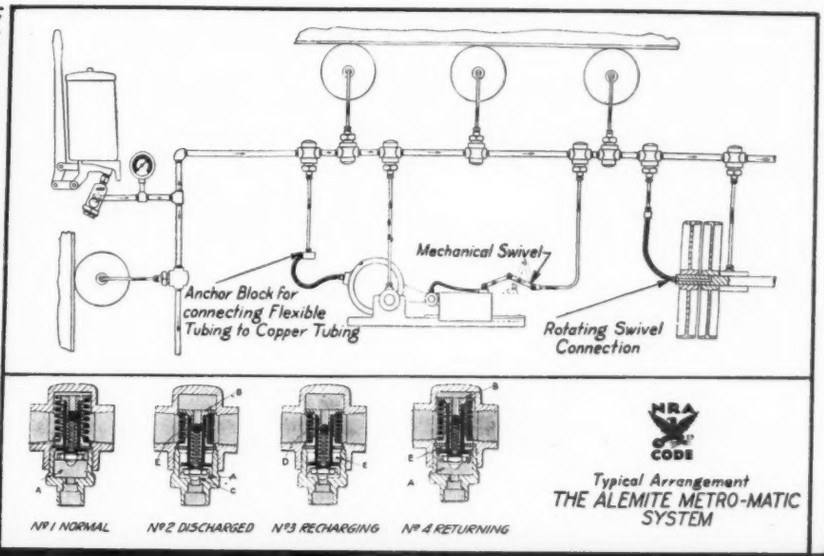
which is mounted the improved balancing device comprising a pair of disks 7 and 8. The disks are held in adjusted angular position on end plate 4 by four cap screws 9, 10, 11 and 12, equally spaced from each other and the axis of the shaft, *B, Fig.* 3. Drawing *C* is a plan view of one of the balancing weights.

An example of how the arrangement of slots, holes and cap screws results in securing a quick balance for different positions of the unbalancing force is shown in drawing *D.* In this case it is assumed that the line of the unbalancing force passes through the hole occupied by cap screw 11. Disks 7 and 8 then are placed in the positions shown, with their centers of gravity opposite the unbalancing force and the ends of their slots in overlapping relation. Cap screws 9 and 11 are placed in their respective holes and screwed down sufficiently to hold the disks in position.

If, after testing the rotor for balance, the

FOR HEAVY-DUTY MACHINERY

— *The Alemite Metro-Matic System of Centralized Lubrication*



NORMAL: Illustration No. 1 shows measuring valve in normal position with chamber A and all lines filled with lubricant from previous operation.

DISCHARGED: Illustration No. 2 shows measuring valve in discharged position, following initial pressure application by pump. Observe that the plunger B has been forced downward, causing lubricant in chamber A to pass down the copper tubing into bearing and closing valve at C, insuring delivery of predetermined volume of lubricant.

RECHARGING: Illustration No. 3 shows measuring valve in recharging position. Observe that increased pressure built up in the pipe line is forcing the lubricant past the ball check D and down into chamber E.

RETURNING: Illustration No. 4 shows measuring valve returning to normal position. Observe that, as the pressure in the pipe line is released at the pump, plunger B is forced upward and lubricant in chamber E passes into chamber A. Upon its return to normal position, the measuring valve is in readiness for next lubrication operation.

● To facilitate the adequate lubrication of vital bearing surfaces on heavy-duty machinery—to meet the demand for simplified, positive, centralized lubrication—Alemite Engineers have developed the Metro-Matic System—a unique and remarkable system that delivers plastic lubricant in predetermined quantities to any number of bearings.

With the Alemite Metro-Matic System, a central lubricant pump is installed on the machinery unit and arranged to discharge lubricant into a pipe line leading to various parts of the machine. Measuring valves of predetermined capacity are located along the line near the bearings to be serviced, and when the pump is actuated, lubricant is delivered to the bearing surfaces through rigid tubing or flexible hose, as the case demands. Metro-Matic is simple, sure, economical, and permits complete lubrication while machine is operating.

The detail drawing shown above furnishes a good example of the flexibility of the Alemite Metro-Matic System—how all types of bearing arrangements encountered in machine design are serviced by its positive action. To get *complete* information on this modern, centralized system, simply write a note on your letterhead to Alemite and full details will be sent to your desk *absolutely free*. Write today.

ALEMITE CORPORATION

(Div. of Stewart-Warner Corp'n.)

1890 Diversey Parkway Chicago, Illinois

ALEMITE

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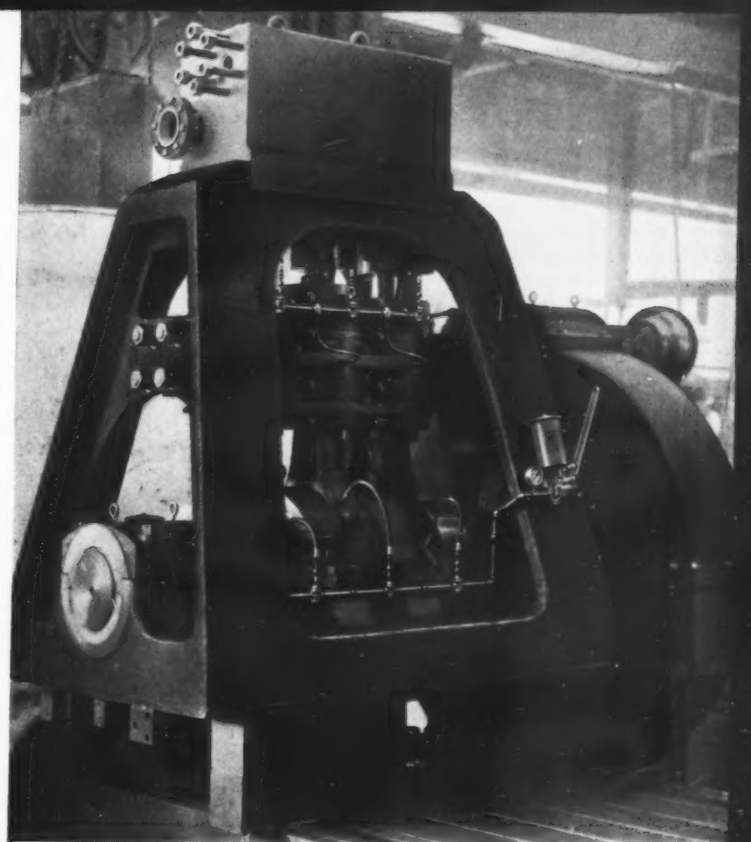
Controlled Application of the Correct Lubricant



This photo shows the Metro-Matic System as installed on a high-pressure pump—courtesy High-Pressure Pump Corp.

combined force of the balancing disks is found to be greater than the unbalancing force, cap screws 9 and 11 are loosened and disk 8 is slid around in a clockwise direction, while disk 7 is moved an equal distance in a counter clockwise direction. After the disks have been adjusted to their proper balancing position, cap screws 10 and 12, *B*, are screwed into place, each passing through a hole 16 in each disk and thereby securing the disks against relative rotation.

Walter J. Newman and Fred W. Munson furnished the idea for this invention.

Cold Rolled Steel Effects Design Economies

(*Concluded from Page* 32)

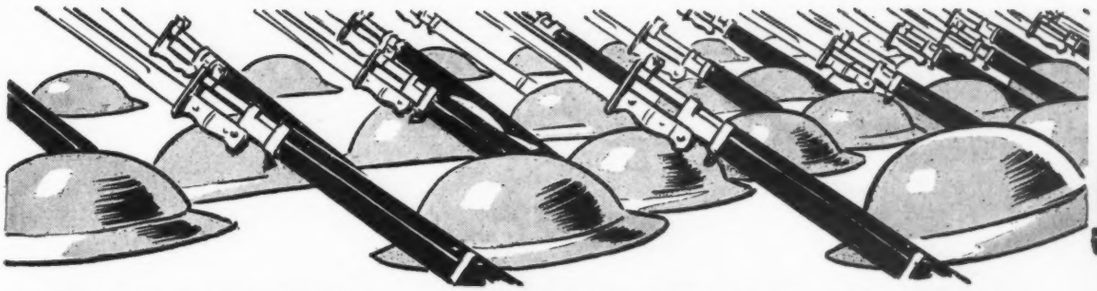
employed to form a square tube that fits over the spindle and on which the two butterfly stops are mounted tightly. Projections on the channels retain the butterflies in position. Because 1000 of the butterflies are required for each voting machine, a press with special compound die is employed. The stock from which they are made is cold rolled strip steel, 1½ inches wide and mounted on a reel. Butterflies are produced at the rate of 6000 per hour.

The handle return frame by which the machine is reset for the next voter incorporates vertical members made as channels formed from cold rolled strip. Horizontal members also are cold rolled strips into which slots are cut diagonally. These slots afford clearance for adjoining moving parts of the machine. Accuracy is essential and must be held within a tolerance of 0.002-inch throughout.

Each square spindle extends through the square hole of a pinion in the vote-counting mechanism that works on the principle of the automobile speedometer. After the voter has turned the desired levers and thrown a switch there comes into play countershifter bars that actuate the vote counting mechanism.

The electric motor and drive used in operating the machine are shown at the right of *Fig.* 3. Provision is made also, however, for manual operation. The unit depicted in the lower left-hand corner of *Fig.* 2 controls the countershifting mechanism, the handle return frame and the opening and closing of the curtains around the person casting his vote.

Because of the seasonal service which voting machines undergo the manufacturers have had to take into consideration possible storage of the units in damp places. To obviate rusting all parts are cadmium plated or parkerized. Exposed parts such as the straight ticket voting handles are plated, chromium over nickel over copper. The cabinet is coated inside and out with baked black enamel.



THEIR STRENGTH

IS THE STRENGTH OF STEEL . . .

Rex Chabelco All-Steel Drive Chain is made in a complete line from 1-inch to 6-inch pitch—for every type of drive requirement.

In this line you will find the strength, the precision and the finish to meet every drive condition. All are built on the Rex Unit Link principle that means a chain that will be long lasting in the field—or in the plant.

If Chain were a new invention . . .

If chain were a new invention many new ways would probably be found for applying it—many new opportunities for economies and for improvements in many types of drives—in plants and on machinery—for its flexibility and range are almost unlimited.

Application Engineers of the Chain Belt Company are always available to help work out your drive or conveyor problems, with a complete line of standard and special Rex Roller Chains, 3/8 to 2½-inch pitch and 270 standard Rex Chabelco Steel Chains or any Special Chain your service may require.

CHAIN BELT COMPANY
1643 W. Bruce St., Milwaukee, Wis.

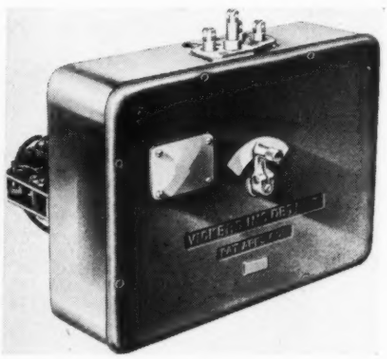
CHAIN BELT COMPANY

REX CHAIN FOR EVERY DRIVE AND CONVEYOR

New Materials and Parts

Panel Enables Automatic Operation

PRACTICALLY all combinations of automatic feeds and rapid traverses is provided by the electric-hydraulic control panel recently introduced by Vickers Inc., Detroit. Starting, reversing and stopping are controlled electrically by push buttons or limit switches, relays and solenoids built into the control panel. A synchronous time relay which is varied by turning



Starting, reversing and stopping are controlled electrically in electric-hydraulic control panel

a dial in the panel provides delayed reverse. The different feed rates and rapid traverses are controlled hydraulically, being increased or decreased by stops (on work table) that depress one or the other of the two center plungers. Length of any working stroke or rapid traverse is varied at any time by simply changing the position of the stops. A lever provides manual control for set-up purposes. Changes in work resistance or operating pressure of the hydraulic system do not affect feed rates; consequently tool jumping and overfeeding are prevented. The panel, shown herewith, provides a complete hydraulic circuit except for pump and cylinder. It is flush mounted with gasket and requires no pipe connections.

Material Resists Acids and Alkalies

A NEW chlorinated rubber base, known as Tornesit, has been developed by Hercules Powder Co., Wilmington, Del., for formulating paints, emulsions, binders, adhesives and plastics having high chemical resistance. The base is used for making coatings which at the same time resist both acids and alkalies. In addition to applications where such acid and alkali resistance is required, the new material is recommended for protection against corrosion, weathering water, steam, dust fumes and gas, and

WHICH FRACTIONAL-HORSEPOWER MOTOR FOR APPLICATIONS LIKE THESE?

Cushioned-power mounting; drip-proof end shields; simplified terminal connections these and many other advantages are available to you in this outstanding motor development

WHEREVER YOU need a compact, reliable small motor for applications that require constant speed, moderate starting torque, and dependable load-carrying ability, select the G-E Type KH.

This finely built motor is available in a wide variety of mechanical modifications (some of the types are illustrated above) which make it exactly matched to the needs of your design. Its ratings — from 1/40 to 1/4 hp. — offer you a wide range from which to choose wisely.

The Type KH motor is but one of a large variety of G-E fractional-horsepower motors for every purpose; this diversified line provides for all conditions of load and mounting encountered in modern products.

General Electric is always ready to work with you. G-E offers an unparalleled background of research and experience, gained through nearly a half century of manufacture of electric products — motors of all types and sizes, wire and cable, transformers — in brief, every electric product. General Electric, Schenectady, N. Y.

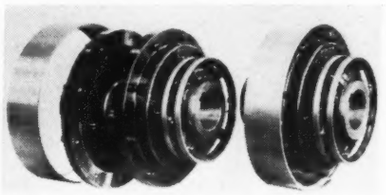
070-89

GENERAL ELECTRIC

also for long life in the presence of such attacks. The new material is noncombustible and is stable indefinitely at temperatures up to 100 degrees Cent. and for shorter periods up to 140 degrees.

Clutch Drives Through Teeth

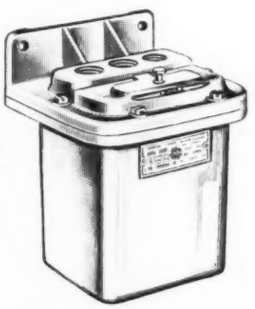
DRIVING through teeth cut into the outer periphery, the new positive engagement clutch developed by Magnetic Mfg. Co., Milwaukee, develops high torques within limited diameters, thus giving the unit application on high torque loads at high speeds. Engagement or disengagement should be made standing still or at very low speeds to prevent injury to the teeth. The clutch, shown herewith, is released through spring pressure and quick engagement and disengagement is obtainable. A special outer shell is provided in the design shown to shield the teeth from grit, dirt and magnetic dust. Normally this shell is necessary only where the clutch is installed in dirty, dusty locations. The clutch can be built in a number of different sizes.



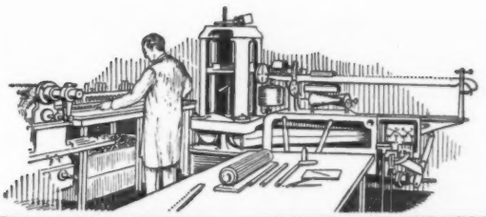
Teeth cut into the outer periphery are used for driving in magnetic clutch

Enclosures Are Explosion Proof

PROTECTION against corrosive gases, by oil immersion, is afforded by the type H (explosion-proof and type J (general application) enclosures recently developed by the Allen-Bradley Co., 1311 South First street, Milwaukee, for the sizes 2 and 3 switches of the bulletin 709 solenoid-operated across-the-line starters. Starters equipped with these enclosures will take care of any polyphase motor requirements up to 15



Explosion-proof starter protects mechanism against corrosive gases



CONFIDENT ENTHUSIASM

"When Mr. C———— and I left your plant we felt confident our tubing worries were solved."

A. D. L.

THIS is a typical reaction of technical men who have placed their tubing problems with Summerill. It has taken close application and a great deal of development to maintain this high expectancy, but so far we've made good.

As specialists in the production of seamless tubing we have naturally had wide experience in processing the greatest possible variety of work with close tolerances—special shapes, grades of steel, etc.

Summerill is daily producing seamless tubing with light walls and smooth finish to a fineness and accuracy most engineers would only consider possible in a laboratory.

Place your tubing problems with Summerill—our engineers can help solve them.

SUMMERILL TUBING COMPANY

SPECIALISTS IN TUBING SPECIALTIES

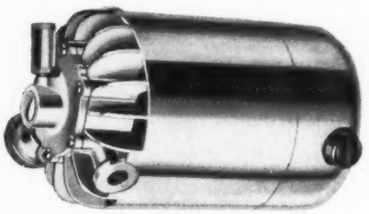
BRIDGEPORT, MONTG. CO., PENNSYLVANIA

horsepower, 110 volts; 30 horsepower, 220 volts; and 50 horsepower, 440-550 volts; as well as self-starting single-phase motors.

The type H enclosure, besides protecting the starter contacts and mechanism against corrosive gases, also meets the Underwriters' laboratories' requirements for equipment for Class 1, Group D hazardous gas locations. The type J starter is used in those installations where oil immersion is required only as a protection against corrosive gases. This equipment is not intended to meet explosion-proof requirements, such as afforded by the type H enclosure.

Motor and Compressor Built Together

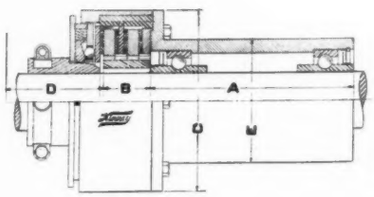
DESIGNED primarily for the spraying of paint, the combination motor and compressor developed by Dumore Co., Racine, Wis., can also be used on sprayers for insecticides, lacquers, etc. The aircooled motor has a 1/10-horsepower rating, and is of the universal type, operating on either alternating current, 0 to 60 cycles, or direct current. The compressor part of the unit develops a dead end pressure of 20 pounds, while a check on the air velocity of these motors show it to be 650 feet a minute at the ¼-inch discharge vent. The unit weighs 3¾ pounds.



Compressor and motor are combined in a single housing for compactness

New Clutches Are Fully Enclosed

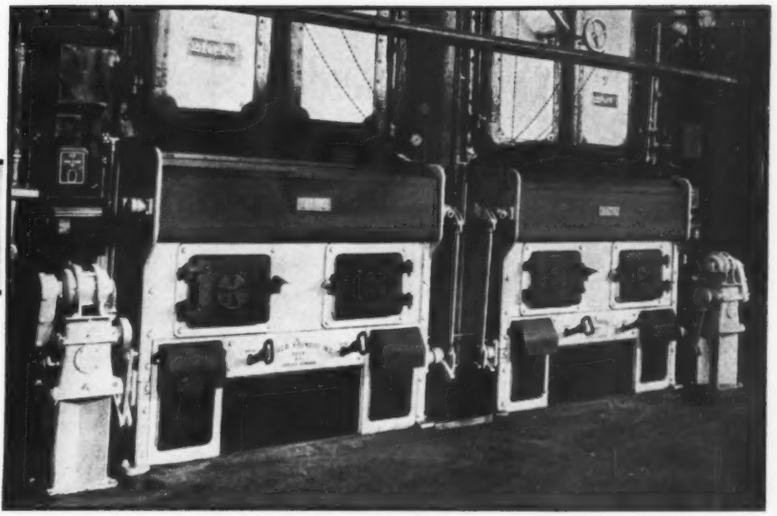
COMPACT, fully enclosed clutches, of the single point adjusting disk type have been brought out by Kinney Mfg. Co., 3541 Washington street, Boston. The clutches, shown here-with, are suitable for use as an integral part of a machine. They are made in three general sizes, single or double disk, with capacities ranging from 1 to 6 horsepower per 100 revolutions per minute. The unit is made either as a

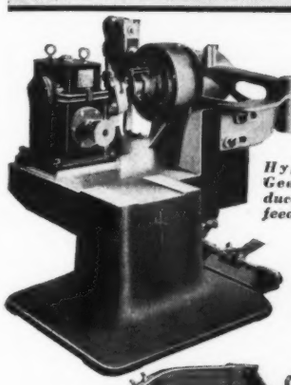


Completely enclosed clutches may be built into the design of machines

IXL
THE MARK OF QUALITY

There's an IXL Unit for Every Application

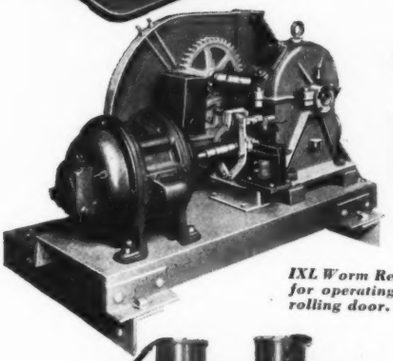




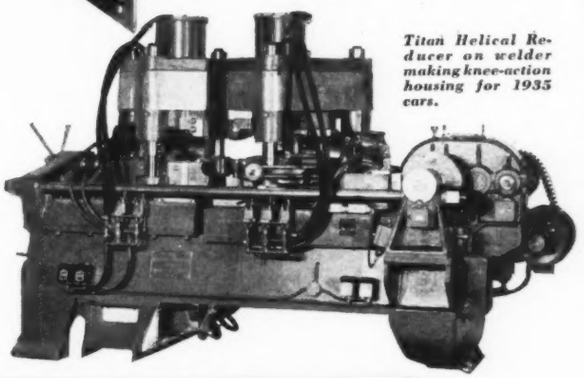
Hygrade reducers driving industrial automatic stoker.

Hygrade Worm Gear Speed Reducer driving wire feeding machine.

Give your salesmen a "Clincher" — with IXL Speed Reducers



IXL Worm Reducer for operating steel rolling door.



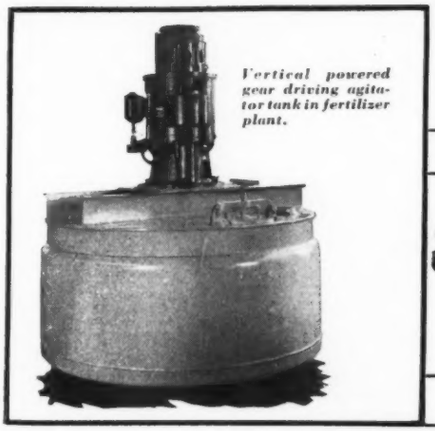
Titan Helical Reducer on welder making knee-action housing for 1935 cars.

"One more argument might have clinched the sale" is the frequent alibi of a salesman. You can give your men this plus argument by standardizing on IXL speed reducers. Prospects know the quality for which that mark stands. They are accustomed to see it on equipment of leading manufacturers. Whatever your drive problem, there is an IXL unit to solve it. Our elaborate designer's handbook makes accurate selection of speed reducers possible. And our representative will gladly call at your convenience to discuss any special requirements.

MEMBER OF AGMA

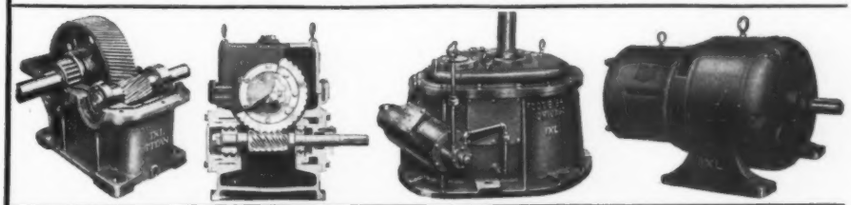
Foote Bros. GEAR AND MACHINE CO.

5303 SO. WESTERN BLVD. CHICAGO, ILL.



Vertical powered gear driving agitator tank in fertilizer plant.

A FEW OF THE MANY STANDARD IXL UNITS



SX	Hygrade	ADM	MDZ
Helical Reducer	*Worm Reducer*	*Heavy duty agitator drive*	*Helical powered gear*

SEE PAGE 70 FOR IXL POWERED GEARS

sleeve clutch, with several types of sleeve bearings, or as a cut-off coupling.

Transmitting capacity of the clutches is in direct ratio to speed at high speeds. The friction disks are faced with burn-proof asbestos which permits extreme slippage in starting a load so that an easy picking up of loads is possible. All working parts of the shifting mechanism are heat-treated hardened steel assembled within the case front, and require very short movement of the shifter cone to engage or release the disks.

Designs Large Variable Transmission

AN UNUSUALLY large completely enclosed variable speed transmission equipped with electrical remote control has been designed by Lewellen Mfg. Co., Columbus. Ind. Dimensions of the transmission are: Overall length 84 inches, width 54 inches (not including shaft extensions), height 38½ inches, capacity 40 horsepower. This unit, shown herewith, is a complete ball bearing transmission. All of the interior parts including the ball thrust bearings, disks and shaft bearings are lubricated from one end of each shaft while the transmission is running.

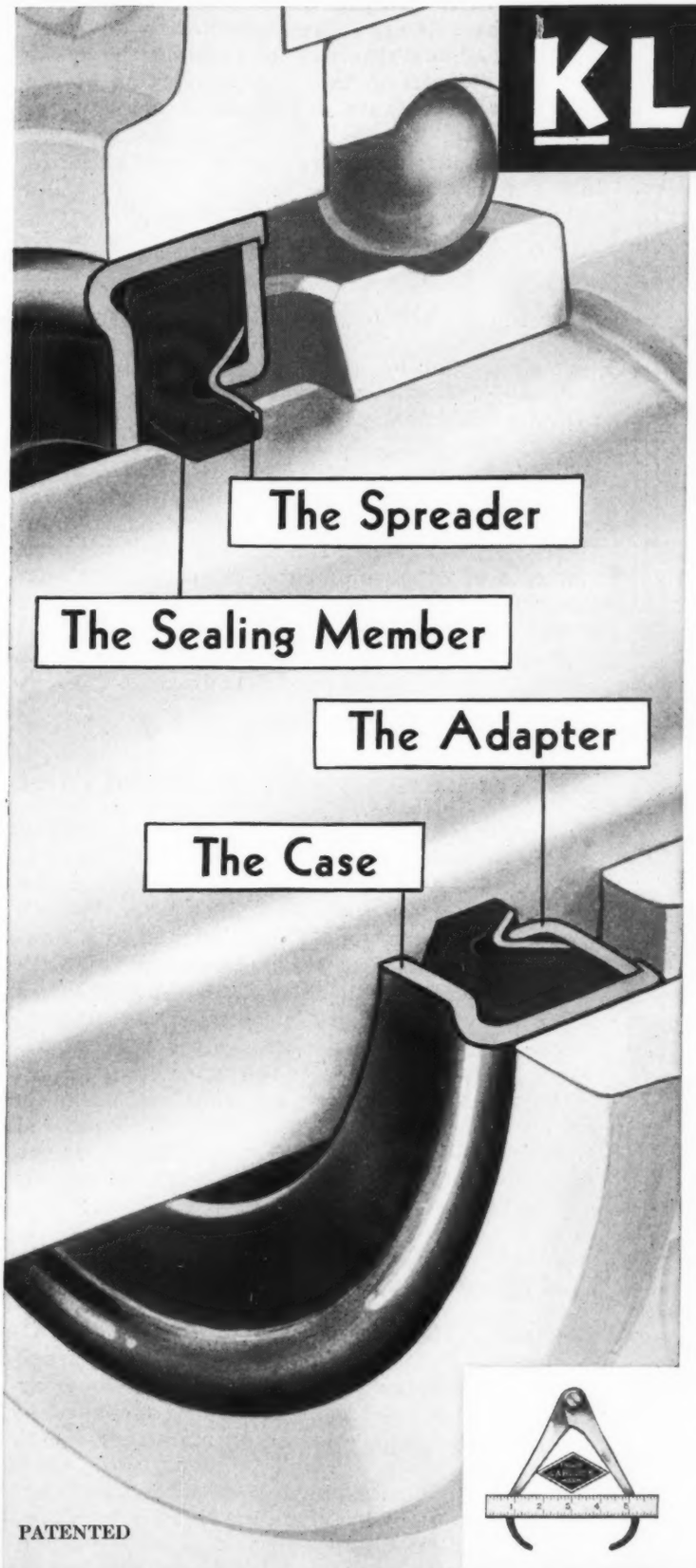
All interior parts in unusually large variable speed transmission are ball bearing mounted

Contacts Are of Composite Material

ELECTRICAL contact buttons made of fine silver backed by steel are now being produced by General Plate Co., 39 Forest street, Attleboro, Mass. These laminated buttons can be furnished with suitable projection areas on the back to facilitate spot welding them to support members of steel, brass or copper and reduce assembly time and costs. The buttons are made with flat or dome contact faces, in all sizes.

Presents New Splicing Method

BY MEANS of a new vulcanizing method for preparing a splice, Compass Cord belts manufactured by Goodyear Tire & Rubber Co., Akron, O., can now be made endless on the drive. This development enables belt users to obtain



PATENTED

KLOZURE

. . . the New GARLOCK OIL SEAL

Solves EVERY Oil Seal Problem

MOST of the world's really great engineering developments are remarkably simple. Take a ball bearing for example; it's merely a steel ball, but it saves millions of dollars every day by practically eliminating friction.

Another extremely simple product which is an important engineering achievement is the new Oil Seal recently developed and patented by Garlock—the Garlock KLOZURE.

This new Oil Seal consists of four parts only as indicated in the illustration at the left. The *adapter* holds the *sealing member* in the *case* and exerts constant pressure against the *spreader*.

The sealing member of the Garlock KLOZURE is not leather, cork or felt; it is a very tough compound specially developed in the Garlock laboratories and molded into a shape resembling the famous Garlock Chevron packing ring.

The Garlock KLOZURE resists oil at high or low temperatures; friction is reduced to an absolute minimum; performance is uniform and efficient. Complete range of sizes. Write for booklet.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Quebec

GARLOCK

the belting in roll-lot, nonendless lengths. The ends of the belt are joined together by dovetailing the load-carrying core of cords at the splice and by vulcanizing the spliced portion of the belt with a portable vulcanizer developed for this purpose. The belt is so constructed that the load is carried entirely by a layer of cords, laid side by side, embedded in rubber, and sheathed in a protecting fabric envelope.

Nickel Alloy Has High Strength

A NEW type of Monel metal which combines the strength of alloy steels with the corrosion resistance of regular Monel metal has been developed by International Nickel Co. Inc., 67 Wall street, New York. The new alloy, known as K Monel, is practically the same as regular Monel metal with the exception of about 4 per cent added aluminum and fractional amounts of other elements. It is readily heat treated and its fully hardened condition shows brinel values above 350, although the material is available in softer forms. Tensile strength is above 160,000 pounds per square inch.

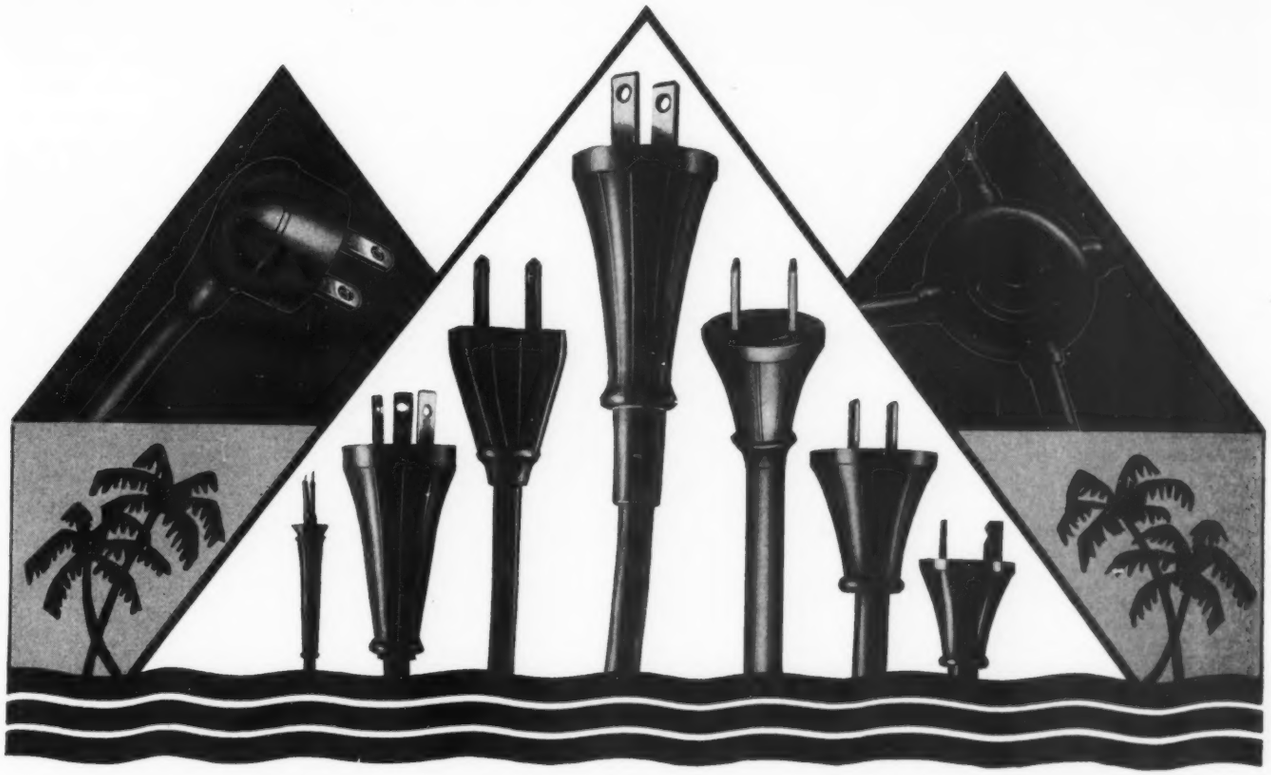
New Process Enables Improved Paint

LIQUID copper paint of high purity has been developed by National Copper Paint Co., 666 Lake Shore Drive, Chicago, following the discovery of a new copper-treating process which enables the reduction of pure copper to a noncrystalline form. The copper, when mixed with a special vehicle, can be applied like any liquid to any surface for rust protection, decoration, etc. The particles produced by the process become shapeless during the special treating, rather than eight-sided as is usual, and remain in suspension instead of settling when mixed with the carrier. Upon application, they coat the entire surface with a virtual sheath of copper.

Offers Line of Bearing Closures

COMPLETE closures for anti-friction bearings, finished and ready to use, for approximately 150 sizes of ball and tapered roller bearings in a number of sizes and types to meet many design combinations are being manufactured by Bearing Appliance Co., Ardmore, Pa. Bolt fastening dimensions have been established, and for each group of bearings having similar diameters a number of parts, all having identically located holes, are provided. Fourteen sizes of cast iron covers for completely closing the bearing housings as well as open covers of various types are included in the line.

Among the latter are covers carrying felts,



G-E ALL-RUBBER PLUGS

AS SIMPLE . . . AS PERMANENT . . . AS THE PYRAMIDS

Like the Pyramids, G-E All-rubber Cord Sets with *moulded-on* plugs withstand the ravages of time. They are the simplest, surest cord sets made — they assure dependable, continued performance.

G-E All-rubber Cord Sets with the plug moulded fast to the cord (not merely attached) keep appliances in constant operation — give years of service — never need replacing. The weak point of the old-type cord sets is entirely eliminated. There is no point of attachment of the cord to the plug on the G-E Cord Sets — the plug and cord are all one. Contacts are soldered to the cord and moulded in rubber — there is nothing to come apart. They defy abuse — are practically indestructible.

The appearance of your product is improved by using the line of G-E All-rubber Devices — moulded fast to the cord. All types of rubber plugs, strain reliefs, connectors, angle caps and delta connections are available — moulded fast to any type cord. They not only meet but surpass all Underwriters' tests and requirements. Only General Electric can supply this well constructed, original line that guarantees satisfaction.

For complete information on G-E All-rubber Devices write Section Q-324, Merchandise Department, General Electric Company, Bridgeport, Connecticut

GENERAL ELECTRIC

ACCESSORY EQUIPMENT

MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

covers with flingers and covers for the accommodation of standard leather or composition oil seals. Numerous shaft extension sizes can be utilized and the varying degrees of inside space offered permits mounting bearings with or without locknuts, in fixed or floating positions and with proper abutting shoulder diameters. A number of the parts are fitted with lubricant and cleaning openings eliminating the expense of these holes in the main housings.

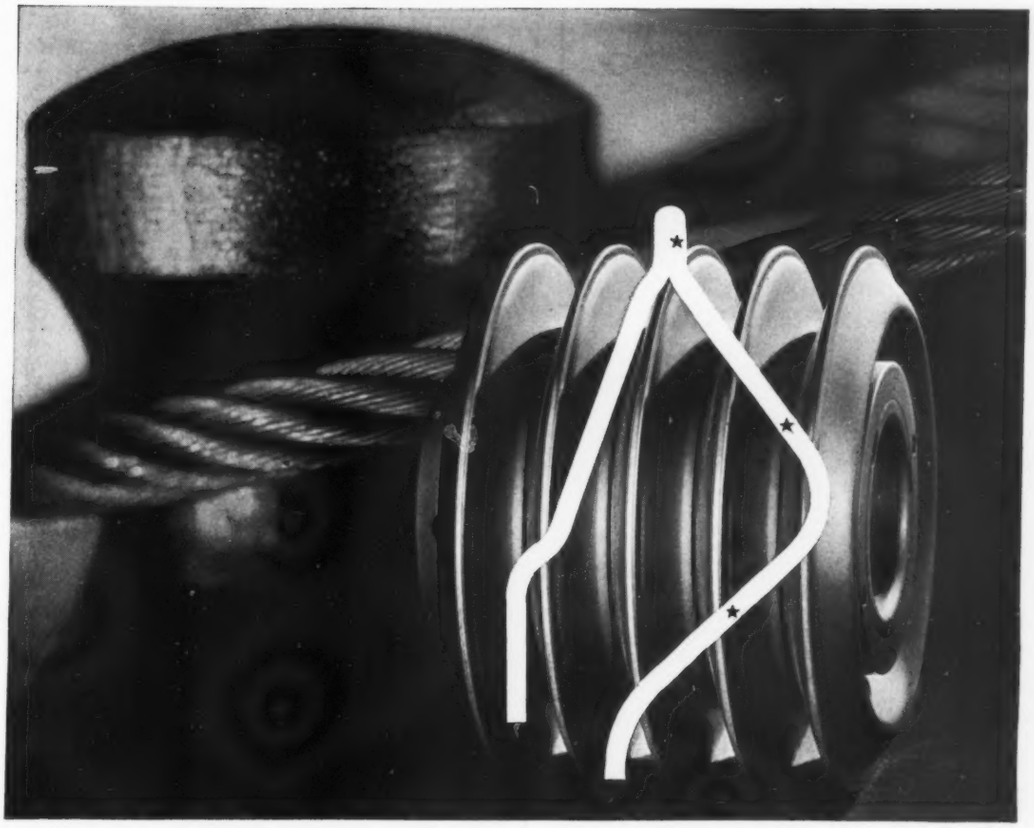
Fourteen sizes of cast iron covers for completely closing bearing housing are provided as well as open covers of various types

Motors Have Integral Brakes

MOTORS with brakes for use on hoists, winches, cranes and similar applications where the load must be held whenever power is shut off from the motor are a new design of Electric Specialty Co., Stamford, Conn. When no electrical power is applied to the motor terminals, calibrated springs press the stationary and rotating disks of the brake together. Suitable brake linings are used on the disks which are mounted on the motor shaft. As soon as electrical power is again applied to the motor, electromagnets counteract the action of the springs and release the braking pressure on the disks, allowing the motor to rotate freely.

Integral brake on motor operates when no electrical power is applied to the motor

The entire brake is built integral with the motor to form a compact, rugged unit. The elec-



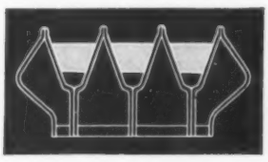
STRENGTH

A mere two and one half inches of steel wire, in the form of a hawser, can handle 330,000 pounds of ship . . . if properly constructed and properly spliced. • A mere seven pounds of high grade pressed steel, in the form of a rotating sheave, can transmit 330,000 foot pounds of power per minute . . . if properly designed and properly fabricated. • The newly designed Duro-Brace Texsteel Sheaves, for Texrope V-Belt Drives, can do this and do it day in and day out under the severest conditions, for, in the new Duro-Brace design, the outside walls are reinforced by convex steel plates, which so greatly increase their strength as to eliminate distortion, thus giving a true-running, vibrationless drive always. • Texrope Drives are 98.9% efficient, silent, slipless, shock-absorbing, require no belt dressing or lubrication, and are not affected by dirt or moisture. • Mail us a card asking for Bulletin No. 2188 which sets forth the advantages which Duro-Brace Texsteel Drives offer you in all matters of power transmission, whether they be simple or complex.

★ ★ ★

Former Design: cross-section showing unsupported outside plate.

New Duro-Brace Design: cross-section showing outside plate braced by a convex reinforcing steel plate.



TEXROPE DRIVES

ORIGINATED BY

ALLIS-CHALMERS MANUFACTURING

ALLIS-CHALMERS

COMPANY · MILWAUKEE, WISCONSIN

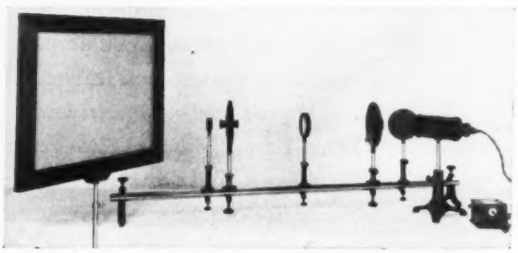
tromagnet windings are connected to the motor supply leads inside the motor, thus simplifying installation and insuring correct wiring. Tension on the springs which govern the braking torque may be altered to take care of a wide variety of operating conditions. Brakes are furnished built into alternating and direct current motors of single, multiple and variable speed.

Switch Designed for Disconnect Use

FOR disconnect use with two-element electric hot water heaters, Switch & Panel division, Square D Co., Detroit, has developed the catalog No. 93011 switch. This switch can also he used for installations where the heater is usually operated on "off" peak load, but provision is made to cut in the heater at regular rates when the occasion demands. It consists of two 30-ampere, 2-pole, plug fuse individual switch bases in one enclosure. The switches are front operated and the design compact.

Photoelastic Testing Is Provided

RAPID and convenient determination of internal strains in optical parts, tubing and manufactured glass parts, as well as qualitative investigation of stresses in transparent models and parts in the laboratory is afforded by the photoelastically and strain testing polariscope being manufactured by Gaertner Scientific Corp., 1201 Wrightwood Avenue, Chicago. This method can also be used to supplement or check the mathematical treatment of stresses in structural parts, and, through the results obtained, weak points are quickly located.



Polariscope provides rapid and convenient determination of internal stress

The stress patterns which appear in colors clearly demonstrate the strains in the specimen. Observations of the image can be made by means of a translucent or reflecting screen. A camera is used for permanent records. A well lighted image 15 inches in diameter can be projected a distance of 6 feet. The optical parts of the instrument, shown herewith, with the exception of the light source, are adjustably mounted on a single 80-centimeter square rod optical bench. The

A QUALITY PRODUCT *rides on a* Quality Chain

The huge Crawford traveling ovens in which Bond Bread is baked are capable of the most delicate and reliable adjustment—due in part to their exclusive use of Baldwin-Duckworth machine finish roller chain.

The best spokesmen for a product are its *users*. The best argument for Baldwin-Duckworth chains and sprockets is the type of concerns who find it capable of fulfilling their most exacting requirements.

Send for our detailed catalog of power transmission, elevating and conveying chains. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

Factories at Springfield, Mass. & Worcester, Mass.

There are Baldwin-Duckworth chains and sprockets for every power transmission or conveying need.

BALDWIN—DUCKWORTH

light source is a 6-volt alternating or direct current concentrated filament lamp. The specimen stage with a quarter wave plate attached is provided with a suitable clip for holding small objects. A separate stage is required for holding and stressing larger test specimens.

Drawing Facility Is Increased

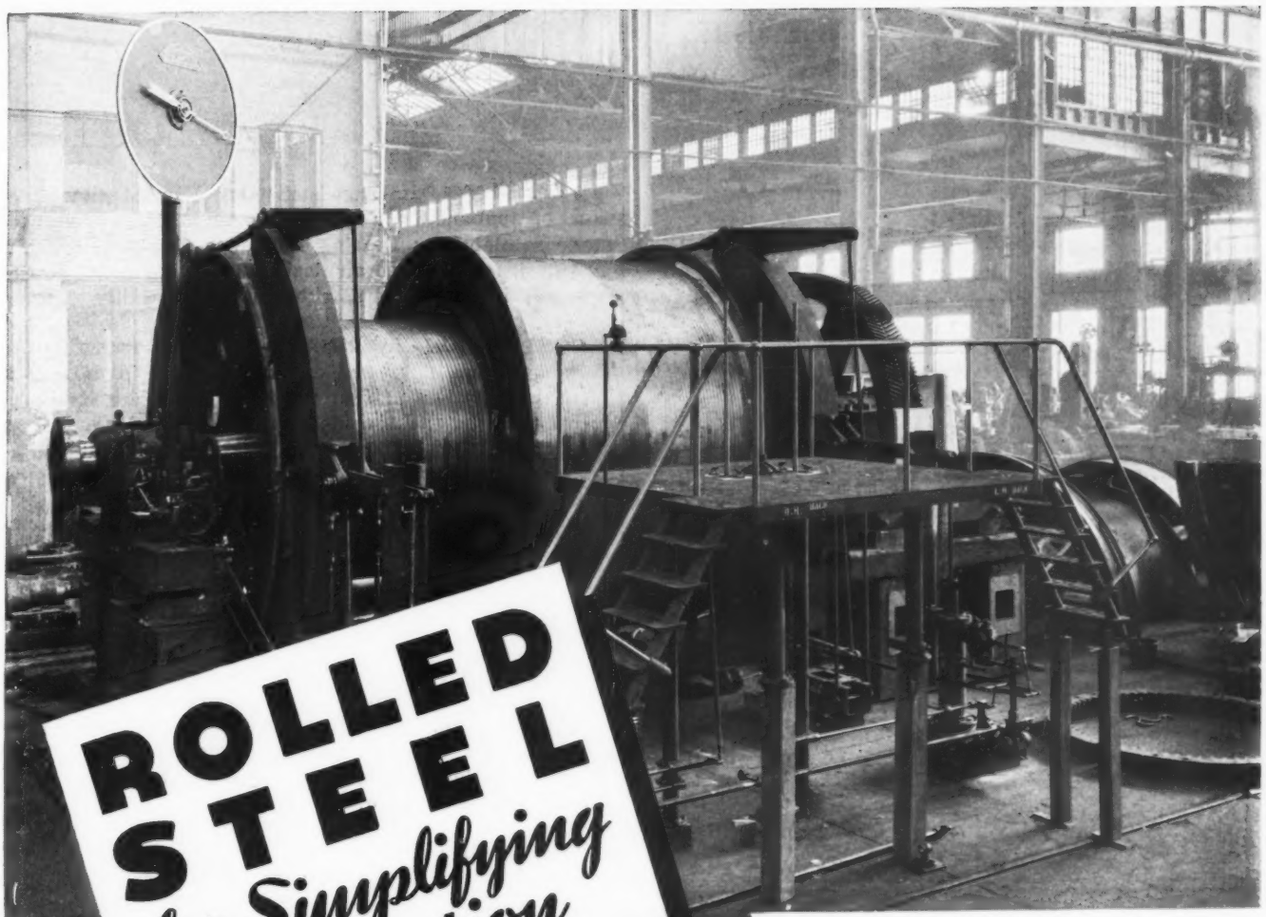
FREEWHEELING has come to the engineering department with the introduction of a coaster drafting chair for engineering tables and a battery of coaster lights for illuminating drafting boards by Hamilton Mfg. Co., Two Rivers, Wis. The chair, shown herewith, in addition to providing an effortless lateral movement in front of an engineering table, permits a forward and backward movement through a pivot in the lower part of the frame. The seat may be adjusted for height and proper distance from the table to fit individual needs. Front legs of the

Drawing tables permit easier movement of the person using the improved equipment

chair are supported on a lateral track attached to the table, with ball bearing fiber wheels running in a channel guide. The outside legs have ball bearing casters which run on the floor.

The new coaster drafting lights consist of three adjustable lights attached to a ball bearing, rolling unit which runs in a channel at the back edge of the board. This battery of lights may be mov d along the back of the board, wherever needed. In addition to the sidewise movement, each individual lamp may be swung in a circle.

In addition to these innovations, the company is introducing a new line of "Steelwood" engineering tables, a combination of the best practices in both steel and wood construction. Framework is of welded steel construction; drawer units are of wood, while the drawers themselves have steel fronts. The tables are being furnished in three sizes.



ROLLED STEEL *for Simplifying Production*

● Here's a typical example of the way in which rolled steel irons out the kinks in a difficult manufacturing job. These mine hoist drums were fabricated entirely from rolled steel. The drums are rolled into two segments, each 180 degrees. (One of these segments may be seen at the right of the photograph.) After assembly, the grooves for the cable are machined. The larger of these drums is 12′ in diameter and will wind 5000′ of 1¾″ rope. Rolled steel provides the strength necessary for a 56,000-pound pull.

Rolled steel provides the means of simplifying many a difficult production problem. It permits greater freedom in design, greater facility in altering a product to meet special requirements.

ROLLED STEEL OFFERS THESE ADVANTAGES

1. Cheaper . . . for most parts.
2. Reduces loss due to defects or discards.
3. Permits inexpensive changes in design.
4. Faster production . . . particularly of new and unstandardized parts.
5. Reduces inventory and pattern storage.
6. Permits prompt adaptation of standard design to special requirements.
7. Eliminates excess weight.
8. Modernizes appearance.

ILLINOIS STEEL COMPANY

208 SOUTH LA SALLE STREET, CHICAGO, ILLINOIS

CARNEGIE STEEL COMPANY, PITTSBURGH

United States Steel Corporation Subsidiaries

BEARINGS—Data sheets showing detailed dimensions of appliances for ball and roller bearings have been made available by Bearing Appliance Co., Ardmore, Pa. The sheets cover cast iron closures including closed covers, open covers with flingers, with felts or for leather oil seals.

COMPOSITION MATERIALS—Formica Insulation Co., Cincinnati, has published a booklet which gives a complete presentation of what the material is, how it is used in industry, how it is made and in what grades and types it is made. Illustrations of applications are included.

COMPOSITION MATERIALS — Decorative plate produced by applying heat and high pressures on superimposed layers impregnated with plastic synthetic resins is discussed in a folder of Mica Insulator Co., New York. The plate can be produced with colors, designs and true reproductions.

CONTROLS (ELECTRICAL)—Condensers of all types for industrial application are illustrated and described in a bulletin of Aerovox Corp., Brooklyn, N. Y., which gives uses of the condensers and their characteristics. Copies of the bulletins will be sent to persons requesting them on company letterhead.

DRIVES—High speed chain drive in terms of what it has done and can do for its users is presented in a highly pictorial 32-page book, No. 1425, of Link-Belt Co., Indianapolis. Many types of applications, on both long and short centers are shown.

DRIVES—Roller chain drives for diesel engines are presented in a reference book of Renold & Coventry Chain Co. Ltd. The book includes complete data on chain drive design, recommended practice, data on selection of chain drives, examples of layouts, rating tables and similar engineering data. Boston Gear Works, North Quincy, Mass., is distributor for the company.

ELECTRIC CIRCUITS—A system for providing mobile electric circuits which consists of an almost closed duct is presented in a bulletin of Switch & Panel Division, Square D Co., Detroit.

PACKING GLANDS AND PACKING—Michigan Leather Packing Co., Detroit, has brought out an attractive illustrated bulletin, No. 701, on its line of mechanical leather packings and oil seals. The bulletin includes illustrations and a description of an unusual and exacting test made on one of the packings.

PUMPS—Worthington Pump & Machinery Corp., Harrison, N. J., has prepared bulletins on Monobloc centrifugal pumps which include cross-sectional views of the pumps and details on their construction.

PUMPS — Rotary positive air pumps are completely described in catalog No. A-135 of Leiman Bros. Inc., Newark, N. J. The bulletin gives comprehensive data on the design and use of the pumps, includes photographs and drawings, and presents complete dimensional data.

PUMPS—Foster Pumps Works Inc., Brooklyn, N. Y., is distributing issue No. 5 of bulletin No. 1001, illustrating

and describing the complete line of rotary pumps built by the company. The bulletin gives details of the pumps and tables of sizes, capacities and dimensions.

SHAPES—Union Drawn Steel Co., Massillon, O., has prepared a bulletin on the effect of cold drawing on the strength of steel which includes photograph of parts made from these shapes.

SHAPES—Steel forms which can be produced on the largest press brake ever built for bending, flanging, forming and multiple punching of both light and heavy steel plate are presented in a bulletin of Lukens Steel Co., Coatesville, Pa.

STEEL—Republic Steel Corp., Massillon, O., has prepared for distribution a bulletin which includes the SAE official steel specifications for alloy and carbon steels. Chemical compositions are included.

WELDED PARTS AND EQUIPMENT—Hobart Brothers Co., Troy, O., has published the second edition of "Electric Arc Welding Manual," by W. J. Chaffee. The book contains a complete technical treatment of arc welding, including data on weldability of metals, types of joints and welds and strength of welds.

Research Publications

Fatigue Properties of Steel Wire. Because of surface imperfections, the fatigue limit of a structural member may be appreciably lower than the fatigue limit determined on machined and polished specimens of the material. This was shown by fatigue tests made by the rotating beam method on galvanized heat-treated steel wire, Swedish valve-spring wire and cold rolled mild steel wire. The fatigue limits of specimens as produced by the manufacturers were 40, 60 and 82 per cent respectively of the fatigue limits of machined and polished specimens. Published by bureau of standards as RP 754. Available through Government Printing Office, Washington. 5 cents.

Impact and Static Tensile Properties of Bolts. Three hundred and sixty specimens were tested, representing all the possible combinations of five different materials (chromium-nickel steel, cold-rolled steel, monel metal, bronze and brass); four different bolt diameters (⅜, ½, ⅝ and ¾ inch); and three different forms of screw threads (American National coarse, American National fine, and Dardelet). These threads are often used for bolts, the U. S. Standard threads being almost the same as the American coarse threads and the SAE threads practically the same as the American National fine threads. In all cases the impact works for bolts having American National coarse threads were less than the impact works for bolts of the same size and material having American National fine threads. Except for the brass bolts and those cold-rolled steel bolts which showed brittle failures, the impact works for bolts having American National fine threads were approximately the same as the impact works for bolts of the same size and material having Dardelet threads. In all cases the impact works for bolts having Dardelet threads were much greater than the impact works for bolts of the same size and material having American National coarse threads. Published as RP 763 by bureau of standards. Available through Government Printing Office, Washington.

MACHINES*

of all types are designed by Executives and Engineers who read Machine Design

Adding machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projector
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

***Machines as classified by the United States Census Bureau**

INDEX TO ADVERTISERS

*Advertisements appear in previous issues.

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MACHINE DESIGN **is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.**

—Cross Sections—

DESIGN is getting to the point where consideration of appearance is as important and rates almost as much attention as the design of the co-operating parts. This method of design has ceased to be a trend, it's a landslide. But there is one point that designers should keep in mind. Any machine that has been efficiently doing its work over a period of years has earned the respect and admiration of its users. If, in redesigning for appearance, we can retain a family resemblance between our new machines and the ones that have proved themselves, we can cash in on the reputation of the machines built previously.

THOSE designers who can't quite seem to make up their minds to go ahead with pioneering designs might note the results of Burlington's streamlined train. This progressive development has brought about an increase of from 150 to 200 per cent in number of passengers carried, a reduction of almost half in operating expenses, and a cost for fuel and lubrication only slightly more than one-fourth the previous cost.

It is perfectly possible for a new idea or result to be based on combination of old ideas and result in a valid patent.

A LOOK around the National Wine and Liquor Show held at Chicago convinces us that designers have again proved their versatility, as practically everything that is to be done in connection with liquors, even to the mixing of them, can now be done mechanically. However, we thankfully note that the actual drinking is still a manual operation.

DO YOUR production men and the guardians of the treasury start ranting and tearing their hair when you specify chromium plating for anything except extremely simple shapes? Well, here is a way to make them your friends for life. There is available a steel sheet, chromium plated before you see it, that can be blanked, cut, formed, jumped on or almost anything else, yet when the part is finished no buffing, polishing or other production step is necessary to produce a beautifully finished part. Heavy paper which will stretch around the bends is applied to the sheet by a special nonhardening cement. When the piece is formed merely strip off the paper and there you are.

LAST month we noted the trend of industrial machine manufacturers away from a standardized color or finish; this month it is refreshing to note that at last domestic machine manufacturers are getting away from the hospital appearance for refrigerators. One of the new models is available in light green, peach and similar tints. In this day and age every housewife tries to maintain a color scheme for her kitchen, and it seems only reasonable that the refrigerator, the most prominent piece, conform to this plan.

YOU'VE seen those sketches by Rube Goldberg where cat *A* sneezes, blowing paper *B*, against swing *C*, etc. Etc. and ETC. Well in one design department any mechanism that seems on first inspection to wander aimlessly all over the place is immediately labeled a "Goldberg mechanism" and it doesn't get into the final machine until every effort has been made to straighten it out as much as possible. It would pay all designers to tack one of Goldberg's sketches in front of him and constantly try to get as far away from it as possible.

Business and Sales Briefs

LINK-BELT CO., Chicago, has moved its Portland, Oreg., sales office, D. L. Shirley resident manager, to Fourteenth avenue and Savier street. The company's warehouse will also be located at this address.

* * *

Synthane Corp. has announced that J. B. Rittenhouse, vice president, has transferred his headquarters from Chicago to the main office of the company at Oaks, Pa.

* * *

Copper & Brass Research association has removed its offices to 420 Lexington avenue, New York.

* * *

L. K. Lindahl, formerly sales manager, has been elected vice president and general manager of Udylite Co., Detroit.

* * *

National Copper Paint Co. with headquarters at 666 Lake Shore drive, Chicago, has been formed to manufacture and market a newly evolved liquid paint.

* * *

John R. Johnson, recently office manager of the Chicago district sales office, Illinois Steel Co., has been made assistant manager of sales of the Milwaukee branch of the Chicago office succeeding A. P. Selby.

* * *

Atlas Supply Co. Inc., 35-39 Woodward avenue, Brooklyn, N. Y., has been appointed as warehouse distributor for rust-resisting Toncan iron sheets by Republic Steel Corp., Youngstown, O.

* * *

Robert Korsan Jr. has been named to succeed Griswold A. Price as manager of sales in the St. Louis district for Illinois Steel Co., Carnegie Steel Co. and Tennessee Coal, Iron & Railroad Co.

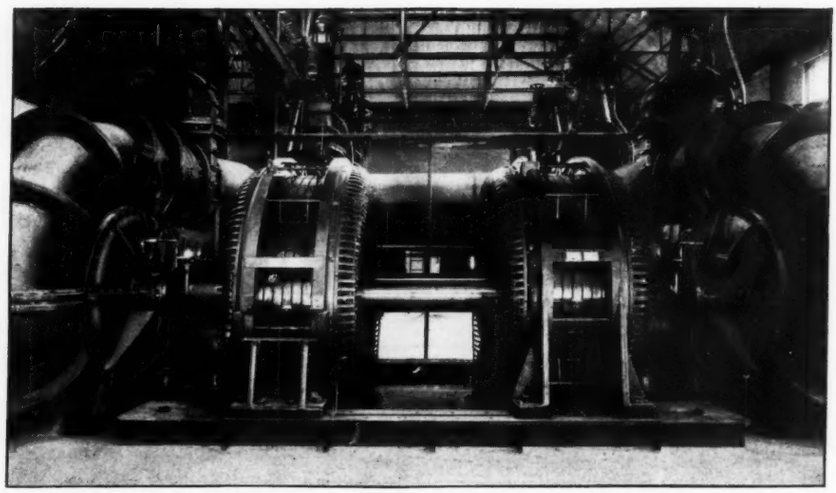
* * *

Fenchurch Export Corp., New York, is requesting that manufacturers send information, catalogs, etc., of engineering and kindred lines to its client, Fred Milnes & Co., 369 Lonsdale street, Melbourne, Australia.

* * *

H. W. Calder has been appointed manager of the New England sales office of Union Chain & Mfg. Co., Sandusky, O. This office is located at 10 High street, Boston. H. F. Edge has been made manager of the Atlanta sales office of the company with headquarters at 101 Marietta street.

F-M MOTOR DESIGN IS BASED UPON *Users'* EXPERIENCE



F-M synchronous motors serving as pump drivers, frequency changers and synchronous condensers in New Orleans.

Few users of F-M motors ever have occasion to come in contact with the men who actually design the product. But users' problems of starting current, speed, slip, torque, operating conditions and a dozen other factors are constantly reported to F-M design headquarters by our widely-flung field forces. First hand familiarity with actual service conditions in industry, and with the thousands of F-M motors in daily use, is responsible for the mechanical excellence of F-M motors.

This background of experience, extending back to the early days of the electric motor, has been responsible for the selection of Fairbanks-Morse to handle such interesting and intricate design problems as that illustrated. This big unit installed by the New Orleans Sewage and Drainage Board contains two 3300 hp. F-M synchronous motors, operating at 13,200 volts, driving two 30-inch Sewage and Trash Pumps. Each set functions as a pumping unit, as a frequency changer to provide a means of interchange of current between the 25-cycle and 60-cycle systems, and as synchronous condensers to float on the line in either system for power factor correction.

F-M Type QC general service squirrel cage motor.

Before you specify a specific type or make of motor for any service, take advantage of this experience. It costs nothing to see what Fairbanks-Morse has to offer. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 32 branches at your service throughout the United States.

Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT 105 Years

FAIRBANKS-MORSE
MOTORS

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